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With this number the period during which the present writer has edited this journal comes to an end, and he has to express his grateful thanks for the hearing that he has received even when advancing opinions contrary to those of most of his readers.

He gives up his connection with the local Agricultural Society with regret. The Society is doing good work for the people of Ceylon, even though the shortly approaching agricultural millennium, which was hailed upon its first foundation, has not yet made its appearance.

A source of great satisfaction to the writer is that the move for which he began to agitate as soon as the Society was formed has now become an accomplished fact, in so far as the Ordinance allowing for the establishment of Credit Societies has become law. Until the villager is freed or nearly freed from the clutches of debt he *cannot* progress in agriculture proper, and the only way in which as yet this freedom has been found is by means of the Credit Societies so successful in Europe and elsewhere. Agitation for such societies was begun at about the same time in India as in Ceylon, but more quickly came to fruition, and now these societies are spreading wonderfully there and making a great difference in local affairs. So much have they grown and so far taken hold of the villager that the local money lenders are showing a desire to invest their money in them. Once let these societies make a good start in Ceylon, and set to work a young and energetic organizer who shall devote his time to working them up, and a change will have to be recorded in local agriculture. Until that happy period dawns, progress must be confined to those who have money, and they will steadily go further and further ahead of the poorer goiyas, a result not to be desired in a well-governed country. All classes should progress equally, and while the capitalist is progressing in agricultural methods, the poorer man should at any rate be progressing upwards to that point where he too may begin to do so.

GUMS, RESINS, SAPS AND EXUDATIONS.

"PARA *VERSUS* CEYLON."

(From the *India Rubber World*, Vol. XLIV., No. 6, September 1, 1911.)

One of the principal factors in estimating the future of rubber is the prospective increase in the Oriental supply. In his interesting review of the subject (in the Portuguese language), "Para *versus* Ceylao," Senhor J. A. Mendes, of Para, has grouped a number of statistical returns, extending the scope of his observations so as to include the Asiatic yield in general.

WORLD'S PRODUCTION AND CONSUMPTION.

Taking the natural starting point, the record of the world's production and consumption during the five years preceding 1910, the following result is shown:—

	Production. Tons.	Consumption. Tons.
1905 ...	69,507	65,727
1906 ...	67,918	71,671
1907 ...	68,646	64,628
1908 ...	67,031	67,081
1909 ...	69,372	70,075

Production and consumption thus kept on about a level during this quinquennial period.

Calling the annual production for 1909, 70,000 tons, its sources are shown to be approximately:—

	Tons.
South America ...	40,000
Central America, etc. ...	12,800
Ceylon, Malay States, etc....	6,500
Africa ...	10,700
Total tons ..	70,000

While a normal or moderate degree of increase might be witnessed from other sources, Senhor Mendes gives prominence to that anticipated from Asia.

ASIATIC EXPORTS OF RUBBER.

Although the 1909 amount quoted is somewhat less than that already shown in the general summary, the general statistical bearing of the figures below is not affected, as embracing the aggregate exports of rubber from Ceylon, Malay States, Sumatra, Java, India, etc.

	Tons.
1905	145
1906	510
1907	1,010
1908	1,800
1909	3,600
1910 (estimated) ...	8,000

The gradual increase recorded for the more recent years is the direct result of the development of planting. This view of the case is supported by the statement that there are now in the Malay States and Ceylon over 600,000 acres, planted with more than 21,000,000 *Hevea* trees, almost in a productive condition to the relative maturity of part of which is due the augmented figure of rubber exports.

FUTURE OF THE ASIATIC RUBBER SUPPLY.

Passing from the field of statistical record to that of estimate, it is not surprising to find divergence of views as to the increase to be looked for within the next four or five years in Asiatic exports, while the general prospect of a larger Eastern yield does not seem to have been questioned. Two pertinent estimates are quoted in this connection to Senhor Mendes, that of Mr. Rutherford (a gentleman largely interested in Eastern plantations) being to the following effect:—

	Tons.
1911	8,100
1912	12,100
1913	17,040
1914	22,670
1915	27,800
1916	35,620

Far in excess of these figures is the anticipation expressed by Sir John Anderson (when High Commissioner of the Federated Malay States), that by 1916 the Asiatic production would amount to 70,000 tons; that being, it will be noticed, just the amount of the world's yield in 1909. Applying the last-named estimate to a forecast of the year 1915-1916, and contrasting the result thus anticipated, with the record for 1909, the following comparison is established:—

	Production. 1909 tons.	Estimate. 19 151/916 tons.
South America	40,000	43,780
Orient ...	6,500	71,940
Africa, Central America, etc.	23,500	26,522
Total tons	70,000	142,242

Estimated increase of product 72,242 tons.

COMPARISON OF BRAZILIAN AND ASIATIC QUALITIES.

While the question at issue has been mainly treated from a statistical point of view, an interesting and lengthy quotation from a recent article in the "Bulletin de l' Association des Plan-

teurs de Caoutchouc," gives impartial prominence to a comparison drawn between the two classes of rubber. It points out that there is no chemical reason for preferring one or the other; both being of the same botanical family and produced under climatic conditions of a similar character. Moreover, it is added, there is no more difference between them than may be found between the product of different regions of the same country.

On the other hand, Senhor Mendes, while giving impartial prominence to the foregoing extract, urges the uniform character of the Para article and the confidence in its use, which manufacturers feel after long years of experience. Reference is likewise made to the fluctuations which had up to the time of writing occurred in the relative values of the two descriptions. These differences have, however, been more or less adjusted by later market developments.

Hence the statistical aspect of the case, apart from that of quality, calls for the prominent attention it has received.

The Question of Consumption.

From figures already quoted, it will be seen that consumption in 1909 was 70,075 tons, as against production 69,372 tons. Whether the surplus to be figured upon is 70,000 tons or a smaller amount at this point, the question of consumption naturally arises and has been dealt with by Senhor Mendes. Taking for the future the basis of a 5 per cent. yearly advance on rate for 1909, he estimates consumption on the following scale :—

			Tons.
1909	...	...	70,075
1910	...	...	73,573
1911	...	...	77,258
1912	...	...	81,121
1913	...	...	85,177
1914	...	...	89,436
1915	...	...	93,908

Deducting from the estimated production 142,242 tons, the estimated consumption 93,908 tons, there would still remain in 1915 and 1916 a surplus production of 48,334 tons, should Sir John Anderson's anticipations be realized, or of 12,064 tons on the basis of Mr. Rutherford's predictions. The Asiatic supply is consequently the dominant factor in the situation.

Estimated Decrease in Amazonian Production.

Of more immediate interest is the estimate by Senhor Mendes of the general result for the year 1910 and 1911, shown as follows in almost the last page of his work: –

	1909-1910. Tons.	1910-1911. Tons.
World's production ...	70,000	70,000
Increase from the East		4,000
		74,000
Decrease from the Amazon (10% of 1906 amount as) ...		3,913
	70,000	70,087
Consumption ...	70,000	73,500
Shortage in production estimated 1910-1911		3,413

Against this shortage would come the excess in Para stock, which was on January 1, 1911, 5,852 tons as compared with 3,278 tons a year earlier.

Effect of Asiatic Increase upon Brazilian Rubber.

With reference to general prospects of the Brazilian product, it is remarked that the rubber from some *seringaes* or plantations may be exported at a profit, owing to its special quality, while the contrary may be the case with that from other locations, where labour is scarce and dear, should values decline through Asiatic competition, or should there be a reduction in demand concurrently with a large and increasing supply of the article. In these last expressions, Senhor Mendes has answered the question propounded by himself, of the probable outcome of present developments in the Orient. The final result will be decided by consumption.

BRITISH GUIANA AND INDIA-RUBBER.

By the Editor "of The India Rubber World."

(From the *India Rubber World*, Vol. XLIV., No. 5, August 1, 1911.)

Third Letter.

Population of British Guiana.—Coolies.—The "Sea Devil" and the Hoatzin.—Gold and Diamonds.—The "Deadly Climate."—Snake Stories.—Early Plantings of *Hevea*.—Experimental Plantings by the Agricultural Department.—Rainfall.—Shipping Rubber.—Packing Seeds.—The Balata Syndicate.

Considering its area British Guiana is very sparsely populated. The latest census record is about 300,000 souls, one-third of them East Indian Coolies. There are but two cities of note, Georgetown and New Amsterdam. The country

is really new and so full of opportunities that one wonders at the way the world has passed it by. The coolies who are brought in as labourers on the large estate are good workers and very tractable and polite. The stranger passing through the coolie quarters of Georgetown is quite likely to be greeted with: "Salaam Papa"—not a claim of blood relationship, but just their deferential way of saying "good day."

Their women are slender, black eyed, well-mannered and gorgeously dressed. For example, one wore a scarlet hat, pale pink waist, deep pink belt, white skirt, green scarf, brown stockings, black shoes. A "real lady," dressed just like the European as she firmly believed. The other labourers are native and West Indian negroes, and they are a uniformly capable, willing lot of men.

Like Northern Brazil, British Guiana has the jaguar, the tapir and the manatee. it has the great bird eating spiders, its big rivers swarm with fish, its forests with game, its jungles with snakes, great and small. It also has strange creatures of its own. It was on a Guiana river that one night I heard a "sea devil" crash down on the surface of the water, and thereafter listened to tales of its enormous size, of its habit of enwrapping divers in its great side fins and feeding on them as they drowned. Then there is the Hoatzin, earth's only known link between bird and reptile—a bird whose young are hatched out four-footed, but who turn into bipeds, their forelegs shedding claws and sprouting feathers as they mature. There are the gold fields, the diamond fields, and the great unexplored reaches of forest and savannah that are full of fascination—a paradise for hunter, botanist, naturalist and yes health seeker. There has been no yellow fever since 1881, and then it was brought in from another country. There is malaria, but one need not acquire it, if careful, and this I would affirm even to the distinguished lecturer, who addressing a New York audience on Brazil and the Guianas. summarized the latter country thus: "Along here we pass the country known as British Guiana, which has a climate so hot and deadly, that no white man can live there." As I pen these lines in New York the thermometer stands at 104 degs. Fahr., with hundreds of deaths and prostrations. Personally I yearn for the safe warmth. the cool nights and the gentle healthful climate of Guiana.

Speaking of snakes there are many in the Guianas, and most of the planters can show the visitor some very sizable skins. I could not, however, learn of any white man who had perished from snake bite. The Government keeps a careful record of all deaths, even of the negroes who go far into the interior to labour at the gold diggings. In looking over the records for a number of years, I found but one case of death by snake bite. Curiously enough the most frequent cause of death among those men seemed to be "accidental drowning."

To even see a snake one usually has to hunt for it. It is easy to find snake stories, however, and those told by the whites are only a bit less imaginative than those of the blacks. A friend of mine, Wilfred Joubert, who has done the Guianas as thoroughly as any one, lay in his hammock in the bush one night and listened to the following story which is typical. The teller was a big-eyed Guiana negro. His audience a breathless, believing crowd of his own colour.

"Yo know Massa Johnson, we a go ride one marnin top he horse en he tenk he go Berbice, but he see one big ting across he path dat he no ken go. He look en he look and he see a one big snake! A true, a snake belly a so big a horse no can leap em, and he sit on he horse all day till 4 o'clock an a snake no pass yet so den he turn back and he get he people for come and look, but when we get back a snake a gone."

Those who believe that any tree flourishes best in its own home, or at least in a country that has the same sort of climate and soil should approve of British Guiana for the *Hevea brasiliensis*. It is Northern Brazil over again. Humid, tropical, with a long and short wet season with a coastal soil really brought down by the Amazon with fauna and flora almost identical, if it is not the home of the Para rubber tree, it certainly is next door it.

It was fully sixteen years ago that the first seeds of *Hevea brasiliensis* were brought into British Guiana, and later plants from the first lot of seeds were sent to different parts of the Colony. The result is that there are a few old trees in existence there. About six years ago the Botanic Gardens in Georgetown began in earnest to import seeds, and up to the present time have raised and sold to planters nearly 200,000 plants of this species.

In addition to this very important distribution, land has been cleared and planted at the Government Experiment Stations at Christianburg, Bonasika, Onderneemig, Pomeroon and Issororo.

These plantings represent several thousand trees, in every variety of soil. A careful record of growth is kept and the future planter will thus have a remarkable fund of exact information to draw from before selecting land and putting in seed.

The Department of Agriculture is nothing if not thorough, and it has not only planted Para rubber at its own stations, but at the stations of the Department of Lands and Mines as well. To-day, therefore, at Turmaturmari, Itaki, Arrawak-Matope, Arakka and Towakaima Para trees are growing, and it has been established that the upper reaches of the great rivers and the interior forest land are well adapted for Para cultivation.

Planters have also taken, of late, considerable interest in Para planting. On the sugar estates many experiments have been tried, and on the higher reaches the trees are doing very well.

Already one estate on the Demerara river has produced Para at the rate of 3 lbs. per tree, tapping only three months of the year.

The coagulating method is a compromise between that in use in the Middle East and in Brazil. It consists in coagulating by acetic acid and then smoking, only instead of the Urucuri palm nut they use the fruit of the Cokerite palm.

The department estimates that about 1,000 acres are now planted to *Hevea brasiliensis*, and this area is very rapidly being increased. They estimate also for drained lands a cost of about $70 per acre for the first year and thereafter $25 per year for upkeep. On higher land the initial cost is $48 per acre.

The rainfall in the colony is all that could be desired for rubber planting, and one can get it in almost any quantity desired and well distributed. It varies from 92 inches on the Essiquibo river to 268 inches in the North-West District.

The shipping of rubber from British Guiana is surrounded by a certain amount of red tape that makes some of the new arrivals rather restive. The course of producer is about this. The shipper goes to the Custom House and gets a supervisor to weigh the lot. Receiving a memo of the weight he proceeds to the Lands and Mines Office to get permission to release the rubber and also to secure a royalty blank. Then follows a visit to the Treasury Department to pay the royalty. The receipt for payment is then taken back to the Custom House for endorsement. Then come two shipping bills which must be officially signed. After this is the securing of the consular invoice and the submission of all of the documents of the steamship company. Then follows the wait until the cargo is discharged before the bill of lading is signed, and then the rush to mail it by the same steamer that carries the rubber. It is true that few errors occur, and the duty on rubber is very low, only two cents per pound, but if one official could be empowered to do all of the signing, and the steamship companies would unbend a bit, it would greatly facilitate matters and be much appreciated by rubber exporters.

Professor Harrison told me of a very amusing instance of planters' generosity in the Middle East. He had sent for some *Hevea* seeds, giving the most minute directions as to their packing and shipment. For example, he specified a parcel's post package of eleven pounds, containing 500 seeds not closely packed with just a little ventilation. etc. The shipper, however, found that the postal cost for 800 seeds would be just the same, so he put in the extra 300, soldered them up tight to prevent "shucking" and sent them along. Of course they fermented, and when they were opened drove everybody away by their fearful stench.

I forgot to mention in writing of the *Sapium Jenmani*, that Professor Harrison in experimenting finds that the latex develops resin when the tree is tapped continuously. The first and second tapping give excellent rubber, the third is slightly sticky, while the fourth and fifth are decidedly resinous.

Referring again to balata, the whole business has been beautifully systematized since the formation in 1910 of the Consolidated Rubber and Balata Estates, Limited. This Company acquired 387 balata licenses and has greatly increased the output. There are some half-dozen lesser companies operating in balata, and about twenty that are really planting Para rubber, with prospects of a great many more in the near future.

THE RUBBER INDUSTRY AND THE EXHIBITION.

A RECORD OF WONDERFUL PROGRESS.

(From the *Indian Trade Journal*, Vol. XXII., No. 278, July 27, 1911.)

Surely it seldom falls to the lot of a writer to discuss within the brief period of three years two more interesting exhibitions than those devoted to the use and growth of rubber in all its phases at Olympia in 1908 and at Isling-

ton in 1911. The first International Rubber Exhibition was in many ways unique in character, and served as an introduction to the public of this country of one of the most remarkable vegetable products in the world. It is true that a rubber exhibition had already been held in Ceylon in 1906 under the auspices of Sir Henry A. Blake, the then Governor, with very important results, but it may well be affirmed that the display over which he presided at Olympia three years ago came as a surprise to all but the very few interested in rubber, either as merchants, planters, or manufacturers. We ventured to express our wonder, after a careful tour through the Exhibition of 1908, how it was that mankind in the past had ever been able to exist without India-rubber, and the more we reflect upon this question, and see all the varied and useful manufactures brought together on this second occasion, the more firmly do we feel convinced that "life without 'rubber' would indeed be a blank," at any rate in a civilized community.

It seems a far cry from the rude elastic "gum ball" of the Indians in Haiti, at the time of first landing of Columbus, to the gaily-painted toy in our English nurseries, but within this compass we have the whole range of the history of india-rubber brought vividly before us. Many notable inventions had to be perfected before the crude rubber of the savage became transformed into the vulcanized substance used for our modern playthings, and these evolutions are fully elucidated at the present Exhibition. It may confidently be claimed that the entire industrial development of the use of india-rubber has become possible through the invention of Goodyear in the United States in 1839 and of Hancock in this country in 1844. The discoveries of these two men were apparently quite independent, but they enabled rubber, treated with sulphur, to be employed for a wide range of useful purposes, and practically laid the foundation for the whole modern system of using this material.

We find, moreover, that within the brief period of a decade mighty changes have been effected in the sources of our rubber supplies and in the methods of preparing the raw substance for use, cultivated rubber threatening to take the place of the wild forest trees formerly employed. Only a few months before the opening of the previous exhibition of London the rubber trade experienced one of the most severe crises ever known in its history, and the value of the best rubber from the Amazon district was reduced by approximately 50 per cent. This was said to be caused by financial depression in the United States of America, which country was always a large buyer of the raw material. Then came about the formation of numerous plantation companies in the Straits Settlements, Ceylon, Southern India, and throughout the Middle East followed by the truly wonderful "rubber boom," during which prices of the raw material reached five times the value at the period of the former crisis. It cannot be said that the increased price of rubber was responsible for the movement in favour of planting the *Hevea*. Exporters had long predicted the speedy exhaustion of the South American and African sources of supply, and almost at the same time rumours were rife concerning the profitable nature of the yield from rubber plantations. Companies followed one another in quick succession, in whose prospectuses hopes were held out of wonderful gains to be derived in the not distant future by the judicious rubber planter.

Some of the assurances of the company promoter were indeed magnificent, but it soon transpired that profits of 200 and even 300 per cent. were being realized by those who had been early in the field in the rubber planting movement. Then the public "fell over one another" in their eagerness to invest in the new Golconda with the result that estates, good, bad and indifferent, were sold for rubber plantations, many of them at greatly inflated prices. Rubber concerns quickly became fashionable, and there were few among the investing public who failed to secure shares in some company or other—sometimes with disastrous results.

As Sir Henry Blake truly states in his introduction to the catalogue of the present Exhibition, many millions of pounds have been invested in rubber since 1908, and it is not difficult to believe that the shareholders in the new companies will be disposed to learn all that they can about the product upon which they have staked so much wealth, and about the machinery used in its manufacture.

In the various collections brought together in the Agricultural Hall it becomes possible to study the behaviour of the latex from the moment it flows from the incision in the tree stem down to the time when, in the form of sheets, cakes, or blocks, it leaves the plantation for shipment to the manufacturer in some far-off land; then to trace its conversion into vulcanized rubber for use

in a thousand different ways; to see the finished article as it issues from the mould or the hydraulic press; and lastly, to study the methods used in testing it and in ascertaining its value for industrial purposes. The machinery employed in the different stages of the manufacture possess many features of interest, and it will be a source of some surprise to find how widely the growth of rubber has become dispersed in many different quarters of the world, and to study the maps relating to this subject. It will be possible from these maps to obtain some general idea of the distribution of the different varieties of trees from which rubber is obtained and to see where each species preponderates.

In order to aid the general reader to obtain good information of the present state of the rubber industry, a series of articles by some of the leading experts has been brought together. Thus Dr. Philip Schidrowitz deals with the chemistry of rubber, both raw and vulcanized, and he indicates the lines on which it has been attempted to produce rubber synthetically by means of isoprene. He also discusses the various uses of waste rubber and the method in which it is prepared for re-manufacture. In connection with the attempt to prepare rubber by chemical means, which has always been held *in terrorem* over the heads of the rubber planters, it is interesting to note that in the present display some specimens are shown of isoprene derived from starch, sugar and even sawdust. The very volatile liquid thus obtained is then condensed by boiling under pressure for three days, when a certain proportion of gelatinous material said to be pure caoutchouc separates out, and it is claimed that by the addition of enzymes to the substance thus prepared it becomes possible to manufacture the synthetic rubber there on view, which will, it is said, vulcanize well and possesses all the properties of the substance prepared from the latex of plants.

In an article on "The Rubber Industry," contributed by Mr. Herbert Wright, the question of future supplies of the raw material is fully investigated, and some account is given of the multifarious uses to which rubber is now applied. Mr. Wright, who had very large experience on the spot, deals with the new plantations in Malaya and Ceylon and their yielding capacity, and he shows that great changes are imminent in the balance of power in the rubber market. Brazil and Africa, from which such large proportions of rubber have been derived in times past, will shortly have to yield the premier place to the plantation rubber, while Liverpool will ere long become a port of secondary importance in the rubber trade as compared with London, which may possibly have to deal with 3,000 tons of rubber monthly in the near future.

A correspondent with intimate knowledge of the Stock Exchange gives his views on the position and prospects of the rubber companies, and takes a hopeful view of the situation. A valuable article by Professor Robert Wallace describes certain of the diseases and pests to which rubber plantations are subject, and his observations deserve careful consideration of the professional rubber planter. It will be seen that most of these foes to the rubber estate are the outcome of careless clearing. Some interesting and graphic accounts are given of rubber collecting in Brazil and in the Amazon district by an authority who has spent many years in the country, and who is able to recount from actual experience the difficulties encountered by the *Seringueiro* and the troubles of the estate owner. On the subject of the new method of obtaining gutta-percha from the leaf instead of the trunk of the *Isonandra gutta*, some facts are given on the authority of Dr. Tromp de Haas, the able Superintendent of the Government plantations at Tjipetir, in Java. It is claimed that by this plan of making use of the leaves a very much larger quantity of gutta-percha can be secured from each acre of plantation, and that the system is less liable to cause injury to the tree than the former process of tapping.

Guayule rubber, obtained from a small bush or shrub covering vast areas in Northern Mexico and Texas, forms the subject of a special article in which a full account is given of the growth of the Guayule plant and the mode in which the rubber is secreted which differs essentially from that of nearly all other known descriptions of that substance. Special consideration is devoted to the mechanical testing of rubber, to the use of rubber as a material for street paving, and to many other matters in relation to this subject which are now attracting public attention. A full description has also been prepared of the Exhibition and of the collections brought together by the different rubber-producing countries, with notes on the conferences in which the expert authorities deputed by the various Governments have taken part.

A remarkable feature is the extent to which the support of Governments of

rubber-producing countries has been accorded to this Exhibition, and the large expenditure which has been undertaken by these Governments in order that the conditions surrounding cultivation and preparation of the product shall be worthily presented. There is also presented the advantage of seeing the exhibits of Brazil and British Malaya, of Ceylon and India, and the Dutch Colonies and other countries side by side, and this has facilitated the work of those who desire to make comparisons of the manner in which the industry is conducted in various parts of the world. In a special article dealing with the Exhibition an account is given of the present position and the prospects of the rubber industry in the old growing districts, and in those territories, many of them within the British Empire, where rubber has only recently been grown. In addition, arrangements have been made for daily demonstrations of various phases of the work, in order that those who are unable to visit rubber-growing countries, or are unacquainted with the details of manufacture, may follow the sequence of the work from the earliest stages until the finished product is ready for the market. The decision to take advantage of the presence in London of a large number of those interested in rubber to hold an International Conference was a wise one. This Conference has been attended by planters, merchants, and manufacturers, and the opportunity they have afforded for the discussion of questions relating to the treatment of the raw rubber and for the various methods of its preparation for the market cannot fail to produce important results. It is only by means of meetings of this character, where all those who are interested in the rubber industry may have an opportunity for a free interchange of ideas, that real and permanent progress can be effected.

It is hoped that by these means the value and importance of the display at the Agricultural Hall may be emphasized, and that the main facts relating to the rubber industry may be brought more prominently to the notice of the public.

RUBBER.

THE LEWA METHOD OF TAPPING CEARA RUBBER.

(From the *Agricultural Journal of the Mozambique Company*, Vol. 1, No. 2, June, 1911.)

Very considerable areas have been planted with Ceara rubber (*Manihot Glaziovii*) in this Territory from time to time. The trees grow well even at Beira in sand, but very little success, if any, has attended the attempts in extraction of the rubber on a commercial scale, although the tree has been in cultivation in this Territory for the last sixteen years. It therefore appeared desirable that a series of experiments in tapping should be conducted in order to prove, once and for all, whether the Ceara tree can be profitably grown in this country. Accordingly, as mentioned in the last issue of the *Journal*, the Mozambique Company has initiated a series of experiments at two of its Ceara plantations, viz., Tambarara and Chibabava. At both these properties different systems of tapping are being followed, in order to decide the method of extraction most suitable to the tree in this country. One of these is known as the Lewa method, which was first discovered about ten years ago by a planter named Kohler in German East Africa, and is named after the Lewa plantation near Tanga. As this system has been successfully and almost exclusively employed in German East Africa for the last ten or eleven years, a description of the method, it is thought, may be of interest to those possessing Ceara plantations in this Territory.

The Ceara tree is of a different nature to Para, and the methods of tapping Para by excision of the bark have not, as a rule, been found successful in the case of Ceara. The Ceara tree has a thinner and softer cortex, and its removal by paring is a more difficult matter and requires very great care in the operation. The knives even in the best condition often tear pieces of the bark away and leave the wood exposed, damaging the tree. Further, in most parts of East Africa the latex does not flow so freely as in certain other countries, and without the use of dilute ammonia only approximately 50 % of the latex can be collected in liquid form, in some cases not so much, the balance coagulating on the tree in the cuts. The Lewa method of incision therefore appears better adapted to the physical nature of the tree than the various methods of excision followed

with Para. The accompanying shows a young Ceara tree having been tapped by the Lewa method.

The tree is fit for tapping when the rough and papery outer bark has been removed. If this has not been recently done, the surface may contain dirt conveyed up the tree by little ants, so it is therefore advisable for the tapper to carry a stiff scrubbing-brush for the purpose of cleaning the surface. The portion of the tree to be tapped is then painted over with a weak acid solution—either acetic, citric, carbolic or fluoric acid. The juice of citrus fruits, such as limes, lemons or oranges, or seeds of the baobab tree soaked in water will also serve the purpose; but clean solutions only should be employed and absolute cleanliness practised throughout. In the portion to be tapped almost point-like incisions should be made, and the latex oozes out and flows down and coagulates in thin ribbons on the bark. (*See Illustration.*)* These incisions should be made 4 in. apart, as each incision drains the latex from 1 in. to 2 in. in every direction from the wound. An ordinary pruning knife is suitable, but every care must be taken that the incisions do not reach the cambium layer; a very narrow chisel, or a flattened bradawl will also serve the purpose; but it is better to use a knife with a guard to prevent the incisions being made too deep. If the latex does not coagulate quickly the acid solution is not strong enough. In damp weather the acid will be required to be stronger than in cold weather. The requisite strength will soon be found from experience.

Formerly, when the system was first started in German East Africa, the rubber was rolled off the tree into round balls. It followed, of course, that particles of bark and dirt became mixed with the rubber, and the product was consequently of poor quality. Latterly, however, this method has been improved upon, and instead of rolling the rubber into a ball it is now rolled off from the tree on to a small wooden roller (*see illustration*)* in such a way as to form a sheet when cut open from the roller lengthways. The latter method is a great advance on the method of collecting in the form of balls, as the tapper can from time to time dip the roller into a pail of water and wash off particles of bark and dirt, and subsequently put the sheet through a washer.

The tapper should be provided with a rough scrubbing-brush, acid and a small hand whitewash-brush, for applying the acid, a wooden roller about 6 in. long by 2½ in. in diameter, and a pail or calabash of clean water. In addition to the tapper it is advisable to have a second boy to follow him to collect the rubber, for if too many trees are tapped at a time the rubber from the first trees will not be so easy to roll off. When rolling the ribbons off they should be distributed over the roller as evenly as possible. It is desirable that the sheets should not be too thick, so the rubber should be removed at intervals according to the desired thickness. The size of the sheets would vary, of course, according to the size of the roller used. It is desirable that the sheets should be of uniform thickness and size, so the rollers should be all the same size. The rubber should not be exposed to light more than is possible, so whenever the roller is not in use it should be kept in a pail of water, and the sheets that have been collected should also be kept in water and brought in from the plantation twice a day, after the morning and evening tapping.

The sheets should then be at once thoroughly washed by passing through a wooden roller or washer. They should be first immersed in hot water at about 170° Fahr. for about 10 or 15 minutes and then taken out and put through the roller. This process should be repeated until the sheets are perfectly clean. They should then be placed in a wooden tub of water containing 5 % of formalin, and remain there from one to two hours. They are then ready to be laid out in a drying or smoking house. If cleanliness is practised throughout and the rubber thoroughly washed, a good marketable product will be the result.

The Ceara tree gives forth its latex more freely at night and in the very early morning, so tapping operations should be commenced as early in the morning as it is possible to see, and discontinued in sunny weather in the middle of the day, being resumed again in the afternoon or evening. The Ceara tree takes a period of rest every year in the dry season and loses its leaves; it should then never be tapped. With the Ceara there should be two tapping periods a year; the first after the rains and the second after the dry season, when the trees have revived and broken into new leaf.

In the next issue of the *Journal* it is proposed to follow up this article with an account of other methods of tapping which are being followed at Tambarara and Chibabava. It is yet too early to give an opinion on the relative merits of the methods under trial, but the Lewa

* Not reproduced.

method has been dealt with first as being the one which is most likely to suit the physical nature of the Ceara tree, and also for the reason that it is one of the simplest and most inexpensive methods of collection; consequently it is hoped it may prove to be the best system to follow in this Territory. It is true that the rubber cannot be prepared quite so clean as that collected in liquid form and appearing in biscuits, but at the same time the cheaper cost of collection is likely to far more than compensate for the higher price the biscuits may realise, and it should also be remembered that it is difficult in this country to collect by any of the incision methods more than 50 % of the latex in liquid form.

A brief reference to the history of Ceara in German East Africa may be of interest to planters in this Territory, seeing that the rapidly-extending cultivation in that country is due entirely to the discovery and adoption of the Lewa method. Ceara was cultivated in German East Africa at Tanga and Dar-es-Salaam between the years 1890 and 1900, but the results were very disappointing, and its cultivation was about to be given up when Kohler discovered in 1900 the method which has been the subject of this article. This method was generally adopted, and the cultivation of Ceara rapidly increased. In 1902 there were about 300,000 trees planted out; to-day there is said to be over 8,000,000 trees in cultivation.

There appears no apparent reason why this method of tapping should not be equally successfully employed in this Territory as it has been in German East Africa.

NOTES AND COMMENTS.

BY RUDOLPH D. ANSTEAD,
Planting Expert.

(From the *Planters' Chronicle*, Vol. VI., No. 38, September 23, 1911.)

Ceara Seed Oil and Poonac.—The following reports on samples of the oil obtained from Ceara seed in Coorg and the residuary poonac have been kindly forwarded by Mr. W. H. Harrison, the Government Agricultural Chemist at Coimbatore:—

"Ceara seed oil was examined and reported upon by Fendler and Kuhn in 1905-06, the results being published in "Chemische Centralblatt, 1906, Part I., pages 768-769.

"From the analytical value obtained, this oil would appear to be a drying oil, similar in character to candle-nut, safflower, Poppy seed, and Niger seed oils. It can therefore be used as a substitute for linseed oil in certain directions, and hence could possibly be used in the manufacture of paints and varnishes. Other uses would be as a burning oil and the manufacture of soaps (probably soft soaps).

"The taste of the samples forwarded would probably prevent its use for culinary purposes, but this would probably disappear on suitably refining the oil.

"If the oil could be produced in a large quantity and at a low cost, the best plan would be to enter into communication with oil merchants at home who would be able to advise if there was any opening for its extended use in the arts and manufactures."

Ceara Seed Poonac:—	Per cent.
Moisture ...	10·96
Organic matter ...	67·05
Sand	3·95
Soluble mineral matter	18·04
Total	100·00
Containing Nitrogen ...	1·72
,, Phosphoric Acid (P_2O_5)	1·96
,, Potash (K_2O) ...	0·19

Remarks.—The cake is of very low nitrogen content, containing only about one-fourth that of ground-nut cake, and one-third that of neem cake, and its market value is therefore proportionately less. It can however be utilized by mixing with other manures rich in Nitrogen, as the organic matter it contains will be useful in producing humus."

Hevea Seed Oil and Poonac.—*Grenier's Rubber News* of 2nd September contains a letter from Messrs. Walter Graham & Co. of Greenwich, England, stating that undecorticated Hevea seed was found to contain 20% of oil of drying nature which they valued at £28 per ton. The residual poonac had the following analysis:—

Moisture ...	11·52
Oil ...	6·08
Albuminoids ...	15·31
Carbohydrates, &c. ...	31·97
Indigestible Fibre ...	32·54
Mineral matter ...	2·58
	100·00
Containing Nitrogen	2·46

It will be noted that the samples manufactured by Messrs. Peirce, Leslie & Co. last March gave a bigger yield of oil than this, and a better poonac on analysis. (See P. C., Vol. VI., p. 122.)

PLANTER'S PAPERS.

V.—Hevea Rubber Wood as Fuel.

(From the *Planters' Chronicle*, Vol. VI., No. 40, October 7, 1911.)

Mr. H. B. Kirk, the manager of Periyar Rubber Estate, has sent the following note for publication :—

"Experiment of Burning Cut Rubber Trees *versus* Jungle Wood."

The rubber trees were cut down one month ago, and with dry weather since the wood is fairly dry. The jungle wood is old dry wood. One yard of rubber firewood weighed out 863 lbs. against one yard of well-dried jungle wood weight 721 lbs.

"The yard of jungle wood lasted eleven hours in my drier, *i.e.*, for a whole day's work, while the yard of rubber fuel lasted seven hours only, and we had to use rather over a third of a yard of this fuel extra to get through the whole day's work. The temperature of the drier was kept steady on both days. The rubber fuel makes far more flame, and in consequence burns far quicker with no special extra heating powers.

"The rubber fuel is far easier to cut, and this consideration would make the cost of the two fuels about equal, and there is no doubt that it will be advantageous to get rid of all trees which are lying about the ground after thinning out is done, also it may help to solve difficulties over shortage of fuel for a time.

"During the eleven hours approximately 1,200 lbs. of rubber could be dried, with a temperature never exceeding 110 degrees."

In his covering letter Mr. Kirk says, "I am personally glad to have found that I can get rid of all the rubber trees cut out and lying about, and getting in the way of tappers, &c.

"It is much easier to cut than jungle wood, and requires very little splitting when stoking. I imagine that it contains large portion of some sort of resin which makes such a flame.

FIBRES.

HEMP HOLDS FIRST PLACE.

Among Island Products—Has Greatly Increased since American Occupation—Offers Splendid Inducements.

(From the *Manilla Bulletin*, October 5, 1911.)

Manila hemp, known familiarly in the islands as abaca, holds first place among the island products and is an industry that offers splendid inducements.

The Philippines have a practical monopoly of the industry, and there is little danger of over-production, as the world's market seems capable of quickly absorbing all that is produced.

In "Reciprocity and the Philippines," by Mr. Harold M. Pitt, appears an article on hemp, the exports of that article from the islands and the possibilities offered in the cultivation of the same. Mr. Pitt says :—

Manila Hemp, known in the Philippine Islands as abacá, is a fibre yielded by a plant similar in appearance to the banana. While this plant has been grown experimentally in many regions, it does not produce a fibre of equality when grown elsewhere than in the Philippines.

The first records of an export commerce for these Islands show that hemp constituted one of the most important products. In 1854 there was exported 12,000 metric tons of Manila Hemp, the value of which is given at $1,477,999. In that year it constituted over 24 per cent. of the total exports. Reports every year since that period indicate that it has held first place among the list of the Islands' products, since American occupation its importance has increased due to several facts, one being that during the Insurrection here against the United States forces the country was badly demoralized and very little attention was given to the cultivation of agricultural products. Hemp grows with practically no attention when it is once planted, and perpetuates itself almost indefinitely. Therefore it was always available, no matter how unfavourable conditions might be for the production of other commodities. As the different ports of the Islands were opened to com-

merce during the period following the Insurrection, large stores of hemp were found in warehouses, and as the world's supply had been practically cut off for several years, the price was enhanced materially, and all of the hemp found a ready market at good figures. In some years since 1898 hemp has made up two-thirds of the total of exports.

Its chief competitor in the manufacture of cordage and twine is the Mexican Sisal, which comes from the State of Yucatan in Mexico. Although Manila Hemp is the better fibre and is rated by the cordage people at 6·50 as against 5 in. tensile strength for sisal, its quality depends to a considerable extent on the care that is given to its preparation. The good fibre comes from the outer husk of the stems that form the stalk, and in order to produce the best grade of hemp this must be quickly stripped and thoroughly cleaned.

A major part of the hemp exported is taken by the United States and Great Britain in almost equal proportions. The market in the United States appears to demand the better grades, and when the quality of the output is uniformly high the largest percentage is found going to that country. When the output is of low quality, the price naturally corresponds, and the English market is found more favourable for it. On the whole, there is almost an equal division between the two countries of the hemp exported.

The following table taken from the Report of the Collector of Customs gives the quantity and value of hemp shipments and proportion sent to the United States since 1898:—

Fiscal Year.		To all Countries.		Percentage of Total exports.	To United States.	
		Tons.	Value.		Tons.	Value.
1899	...	59,840	$ 6,185,293	45·1	23,066	$ 2,439,169
1900	...	76,708	11,393,883	52·6	25,763	3,446,141
1901	...	112,215	14,453,110	54·6	18,157	2,402,867
1902	...	109,968	15,811,316	58·3	45,526	7,261,459
1903	...	132,241	21,701,575	54·7	71,654	12,314,312
1904	..	131,817	21,794,960	58·8	61,886	10,631,591
1905	...	130,621	22,146,241	59·6	73,351	12,954,515
1906	...	112,165	19,446,769	59·5	62,045	11,168,226
1907	...	114,701	21,085,081	61·7	58,388	11,326,864
1908	..	115,829	17,311,808	52·7	48,813	7,684,000
1909	...	149,991	15,833,577	51·0	79,210	8,534,288
1910	...	170,788	17,404,922	48·6	99,305	16,399,397

Hemp is grown pretty generally throughout the Islands, but thrives best in the central and southern divisions. There are still available abundant areas of land well adapted to its cultivation, and the profit in the industry can be made very large if care be given to the end that the best grade of fibre is produced. As the Philippines have a practical monopoly of the industry there is little danger of over-production, and the world's market seems capable of quickly absorbing all that is produced.

Hemp matures in about thirty months after planting, and there are little shoots called suckers that grow from the roots at the base of the stalk which may be replanted or will mature by themselves when the main stalk is cut down. The only cultivation required is in keeping the soil between the plants in suitable condition. The industry can be carried on in conjunction with the growth of other agricultural products, and is one that offers splendid inducements to the individual who can give his time in addition to the investment of a small amount of capital.

BAMBOO HATS: A GROWING INDUSTRY.

Received Remarkable Impetus by the Passage of the Payne-Aldrich Bill—Over 600,000 Exported.

(From the *Manila Bulletin*, September 29, 1911.)

A growing industry and one that promises to experience a steady growth in the future is the manufacture and export of bamboo hats, which has received a remarkable impetus since that passage of the Payne-Aldrich Bill providing for the free admission of these hats into the United States.

The following article on bamboo hats is taken from "Reciprocity and the Philippines," published by Mr. Harold M. Pitt:—

Among the lesser industries of the Islands is the manufacture and export of hats made of bamboo. This is an industry that is carried on in the homes

of the natives of certain sections of the islands, and the work is all done by hand.

France is the best customer for these hats, and in 1909 took 227,603, valued at $73,327 out of a total exported of 440,842 valued at $142,480. The Payne-Aldrich Bill provided for the free admission of Philippine products into the United States, and opened up a new market there for these hats, and in 1910 there were exported to that country 176,938, where in the preceding year there had been but 12,169. The total exports in 1910 increased to 600,486 hats, value $276,309.

As the hats are very favourably received wherever introduced and are comparatively cheap, the industry is one that will probably experience a steady growth. The material for their manufacture is found in almost every section, and as the demand increases the industry will doubtless be more generally introduced among the people, thus adding in a substantial way to their earning capacity. The making of these hats does not interfere in any way with the agricultural pursuits of those who are engaged in the work, as the women and children devote their spare time to it.

EDIBLE PRODUCTS.

PADDY CULTIVATION IN CEYLON DURING THE XIXTH CENTURY.

By E. ELLIOTT.

(*Continued from page 397.*)

THE THIRD PERIOD, 1857, SAW THE RENAISSANCE OF PADDY CULTIVATION IN CEYLON.

The credit for this is primarily due to one man, John Bailey (son of a former Archdeacon of Colombo), who entered the Civil Service on 1st January, 1848, and became in March, 1854, Assistant Agent of Badulla *vice* Philip Braybrooke, appointed Principal Assistant Colonial Secretary.

Others, whose names should be mentioned in this connection, are Woodford Birch and Oswald Brodie, while Adams and Churchill accompanied Bailey in the exploration of the Ellehara canal;* their report of which attracted Sir H. Ward's attention, but led to no practical results, owing to the absence of population in that part of the island.

In 1855 Bailey wrote a most striking and weighty report on the irrigation works of Uva, beginning, "The present condition may be summed up in a few words. The greater number are utterly ruined and all are dilapidated." And again, when writing on commutation in 1855, says: "I have turned my attention much to it and to agricultural matters generally," and adds with becoming modesty, "my views may be wrong, and I do not presume that I have sketched anything new or original. Of course, if my suggestions meet with approval, I shall have the satisfaction of feeling I have contributed to the good of the people over whom I have been placed." Sentiments that shew the spirit of Turnour had descended to him.

One of his successors, Mr. Sharpe, calls him "the originator of almost all that has been done in our time for the regeneration of Uva." But he deserves credit for far more than this; for the renaissance of paddy cultivation throughout the island is due to his familiarity with its wants at the time and his knowledge of Sinhalese modes of working. These convinced him that the most pressing want was the restoration of the old communal customs (which had shared the fate of Rajakariya) for securing co-operation in agricultural operations and the maintenance of minor works capable of execution by the cultivators themselves; as well as the power of the well-disposed majority to coerce the recalcitrant minority when necessary for the purpose through the ancient Gangsabawa or Village Council.

The Village Council is a very old Eastern tribunal, and existed throughout

* *Adams* was originally a planter who, in the outbreak of the Rebellion in 1848, rode across country to Trincomalie with orders for the garrison to march to Kandy. For this service he was appointed to the P. W. Department, and acted as Assistant Agent of Matale and Itinerating Magistrate. He spoke Sinhalese well and was a famous hill climber.

Churchill (an Engineer by profession, came out to the Survey Department, but resigned and turned planter) was the scientific member of the exploring party. He used in after years to relate the difficulty they had in obtaining local information. One day they came on and captured two "wild men," one of whom was most garrulous, but the other remained silent, and on being pressed as to his companion's statements, exclaimed "Gajagal palane boru," (elephantine rock-splitting lies!" He shortly after joined the P.W.D. and eventually became Director.

Ceylon under the name of Gansabawa when native rule prevailed. In Southern India the corresponding institution was the Punchayat (Council of Five) which continued to be a recognised minor tribunal under the British rule, and as late as the sixties, if not still, a record of its cases figured in the published Judicial statistics. Under the Dutch regimé in the Western maritime districts of Ceylon the institution disappeared, but Pridham states that "in 1781 a species of deliberate Council composed of the Chiefs of the Mookoowas prevail under the auspices of Mr. Burnand at Batticaloa, and that under its fostering care the progress of the province was rapid, its population doubled, and *its produce in grain was quadrupled.* On the arrival of the British this institution fell gradually into disuse, when the rapid decline in the industry of the province drew the attention of the authorities to the subject, and Sir Alexander Johnston (Chief Justice 1811-20) prevailed on the Governor to re-establish it. The result was soon again visible, but from some cause the boon was discontinued and the province reverted to its primitive state."

In the Kandyan districts on the other hand "such tribunals for settlement of village disputes" (writes Forbes in his Eleven Years in Ceylon, 1837) "had long existed. They were composed of the head of every family residing within its limits, however low his rank or small his property. From this tribunal there was an appeal to the District Council (Rata sabâ), but in 1828 District Councils only lingered in the remote province of Nuwarakalawiya, and even there were seldom used."

But Brodie, who was Itinerating Magistrate and Assistant Agent of that district (1848-52) in an interesting paper (published in *C. B. R. A. S. Journal*, 1856) gives a detailed account of the agricultural customs then prevailing. He describes "how each village is settled by a little colony headed by two or more leaders or elders called Gamerala, who had in virtue of this certain privileges and rights." He then explains the mode of working the "Bethma" system, so as with a limited water supply to ensure the cultivation of contiguous lands, irrespective of the actual proprietorship, and so lighten the labour of watching, fencing and irrigation, which would become very harrassing if the cultivated portions of a tract did not adjoin. He adds further: "If a man refuses to give his due share of work or money to the repair of a work, he cannot lead water to his field till he has repaid those who have laboured."

In a letter to his chief (Mr. Dyke) Brodie "largely anticipated the policy ultimately adopted, of a benevolent compulsion of labour for their own good from the cultivators."

In other outlying districts similar customs existed, though their general observance could not be secured, to the great detriment of the industry; but there was no second opinion in rural native circles of the necessity of providing machinery for securing their specific performance *by all.*

Sir Henry Ward's advent and an early visit to Badulla gave Bailey his chance and no doubt he pressed his views on the new Governor; whose next stage was Batticaloa, where he met Woodford Birch, equally full of irrigation works and capabilities. It is not surprising that in H. E.'s minute of that trip *Irrigation* is written very large; but what was of more importance, he recognised the necessity for some legal measure to enforce the observance of the ancient customs relating to paddy cultivation and the maintenance of village works, as well as the promising field for remunerative outlay on large schemes of irrigation.

He further recognised the claim of the paddy cultivator as a large taxpayer for fully half a century to the British Government who alone had got very little back for his money. No question of repayment or interest on outlay kept him from immediately sanctioning expenditure on works in Batticaloa, and subsequently in the Southern Province at Kirema and Urubokka. He further made a most important concession as to the sale of land suitable for paddy cultivation, allowing it to be paid for in four annual instalments, instead of within one month of purchase. He also approved of Crown lands being given out for cultivation for a share of the produce, before survey, which enabled many a poor man to take up land, and make money to buy it, even though exposed to the risk of competition at the subsequent sale. By this arrangement Government was no loser, indeed a gainer, as the price eventually secured was as a rule largely in excess of what would have been obtained by immediate payment at waste land rates.

All this led in 1856 to the Legislature passing the first Paddy Cultivation Ordinance which empowered the Governor to proclaim irrigation districts, within which owners of paddy lands could make rules embodying the ancient customs; it also provided for the election of headmen to carry them out, and

empowered the Gangsabawa or Village Council to try and punish for breaches of such rules by fine.

This measure was readily accepted and acted on in many parts of the island, and the Ordinance was especially put in force in all parts of Batticaloa, Trincomalie, Uva, Matale, Matara and Sabaragamuwa districts, and there were further sixty-seven districts proclaimed in the Western, fifty-nine in the North-Western, fourteen in Nuwarakalawiya (then of the Northern Province), and two in Kegalle.

The general interest taken by a number of district officers in holding meetings and framing rules, and the operation of the rules themselves, undoubtedly gave a great impetus to the cultivation of paddy, but to adequately judge of the benefits which resulted from the important step it is well to notice shortly the condition of the industry during the years immediately preceding 1856. The production of paddy in Ceylon apparently touched bottom in 1849, in which year there was a greatly deficient rainfall and the Revenue fell to Rs. 33,510 (the lowest figure since 1830), though the price of paddy has been rising and was then about 60 cents a bushel, and the equivalent crop about 2¾ millions bushels. From this depth there was slow recovery by 1854, when the probable crop was 3½ million bushels. There was probably some further advance in 1855-6, as the climatic conditions were more favourable, but unfortunately I have not the figures to continue the comparison; there was, however, a serious outbreak of murrain amongst cattle in 1855, all through the island but especially in the Central Province, which may have affected cultivation.

After 1856 the efforts of District officers to give effect to the compulsory co-operation provided by the new measure were heartily seconded by the cultivators, and as Bailey recorded in reference to Uva, "The people are astonished at the abundance of water which has been the consequence of their being legally obliged to do the work necessary to their own interests."

Once more the truth was vindicated of the old proverb that "Heaven helps those who help themselves," as in the (agricultural) years 1857-1858 the rainfall exceeded 100 inches, and the crops secured rose to 4·75 in the former year, while that of 1858 was probably six million bushels, a record never previously equalled in Ceylon. The foregoing figures have been deduced from the Revenue returns, but the earliest Blue Book returns now available to me, give the crop of 1862 as five million bushels, off an acreage of 578,000, though the rainfall was decidedly moderate. But the most important and visible results were in Batticaloa where Woodford Birch's* energetic administration secured a considerable outlay by Government in irrigation works and resulted between November, 1857, and May, 1861, in no less than 7,400 acres of *new* land being taken up for paddy cultivation, while the area actually cropped rose from 22,638 acres in 1856 to 41,380 in 1867, and the revenue from Rs. 24,000 to Rs. 60,690. Further, the increased tithe on the lands benefitted by the new irrigation works amounted £950 or 5 % on the total sum spent, or 7 % exclusive of the outlay on the foundations of the incompleted Sengapaddi dam which were however utilised in later times and added to the success. No wonder then that the exports of Batticaloa paddy coastwise to Jaffna amounted in 1866 to 94,000 bushels and reached 105,000 in 1869, besides the quantity converted into rice and sent by tavalam to the Badulla Estates.

(In this connection perhaps it's as well to correct an amusing mistake by Sir John Keane, who, as proof of the present prosperous condition of Batticaloa, states that the importation of 43,000 bushels of rice and 6,000 bushels of paddy in 1869 was for "the use of the population!" Needless to say it was all sent on to the Badulla Estates for the Tamil coolies by tavalams, which competed successfully even after the cart road was opened as late as 1890 to some parts of Madulsima.)

Brodie,† (who had already done good

Note.—The only meteorological record for this year I can find is published in A. S. Journal, which gives the rainfall at Batticotta (Jaffna) for the first nine months of the year as 3·46 inches.

* He was acting Assistant Agent at Batticaloa from August, 1658, to May, 1862, but was District Judge for two years before and two years after, so was connected with the district from March, 1856 to September, 1864.

† Brodie's career had a romantic side which deserves record. After serving at Anuradhapura he went home on leave, married and induced by a rich uncle to proceed to America under promise to make his heir, he resigned the C. C. S. But it was found that to succeed to his relative's immovable property, Brodie would have to be naturalised. This involved, however, not only taking an oath of allegiance to the United States, but a special abjuration of allegiance to the Queen of England. This latter he refused to do, and on his uncle's death he only received a moderate settlement in money. On a representation of the circumstances to the Secretary of State, he

service in Nuwarakalawiya) early in the fifties as Assistant Agent at Matale (1858-61) co-operated heartily in working the Ordinance. It was under his auspices the writer undertook his first essay in irrigation by improving the small tank at Dambulla and providing it with a masonry overfall, which increased the storage considerably.

In the Giruwé Pattu benefit accrued from the restoration of the Urubokka and Kirema Dams, for turning the upper waters of the Matara river into the less favoured valleys. These works certainly helped the cultivation as intended, but no separate figures of the increase of revenue in the village served seems to have been published. A substantial and early return was however secured by the high prices paid for the Government Crown fields benefited, and which sold at an average of £15, indeed some went as high as £45 per acre. By the way this credit has never been shown in any of the C. I. B. returns as against the Rs.86,000 spent on the works.

In the North-Western Province where, as already stated, irrigation districts had been proclaimed, the development of cultivation was most remarkable, especially in the Seven Korales where it rose from 15,500 acres in 1855 to over 60,000 in 1865, both years favourable to cultivation; an advance which, I may add, was maintained and indeed improved on, before any expenditure on irrigation was incurred in the district, or the restoration of the village tanks taken in hand by Government; but the introduction of the Ordinance undoubtedly had its influence, as well as the transfer of the head quarters of the Agency from Puttalam to Kurunegala in June, 1856, in securing this rapid development.

There is, it seems to me, a lesson to be learnt and a moral to be drawn from the facts set out in this part to which I desire to call special attention. It has been already mentioned that Sir Emerson Tennant in 1845 spoke of a parlous condition of paddy cultivation, and made certain proposals; but there were no funds to carry out the repair of the Irrigation works he rightly desired, and his Western remedy was additional taxation, which led to trouble and fiasco; whereas Woodhouse's modernized adaptation of Rajakariya for roads succeeded. Similarly though Bailey may have, as he says, not sketched anything new or original, it was his adpatation of the old customs to present circumstances which secured gratifying results, and the rescue of an important agricultural interest, probably from extinction. I would these two important lessons in legislation and judicious government were more borne in mind, and more frequently followed in lieu of the more usual effort to rule on principles suitable in Western lands, but often ill-adapted for Eastern people.

In May, 1858, Bailey, who had married Sir Henry Ward's daughter, was made Principal Assistant Colonial Secretary as were his three predecessors Braybrooke, Raudon Power and Kenneth Mackenzie, as Badulla was then considered the most important assistant agency of the island. Power and Braybrooke both became Agents of the Central Province, and so no doubt would Bailey, but that unfortunately his health broke down, and he had to go on leave and subsequently retire on a small pension (£363) on the 16th May, 1863, but only lived for a few years in England, where he held an Inspectorship of Factories.

Bailey's services have on various occasions been duly acknowledged in print officially and otherwise and most deservedly, for undoubtedly of the present flourishing condition of paddy cultivation it may truthfully be said or sung :—

> "T'is he chalked forth the way,
> Which brought us hither.'

The expenditure on irrigation during Sir Henry Ward's regime was Rs.480,000, and the principal works executed were the Urubokka and Kirema dams and channels, and the Deviturre dam* (Rs. 66,000) all in the Southern Province; and in the Eastern Province, Ambarai and Ericaman tanks and the foundations of the Sengapadi dam on the Pattipolla aar. The latter group were restorations of works carried out over a hun-

was specially reappointed to the service in a position analogous to that which he occupied previous to his resignation. His first office on return was as P. M. of Matara where he promptly dealt with some Moors who, in a riot, called out the English Raj was over, as, in view of the mutiny then prevailing, Sir H. Ward had despatched the English regiment in the island to India. "Perhaps so," said Brodie, "but meanwhile you will do one month's hard labour," which quite extinguished any disloyalty which may have existed. He too had to retire on account of ill-health in 1864.

* This work was undertaken to keep the floods of the Ging ganga out of a large tract of fields, but no provision was made for the drainage of the direct rainfall, hence it proved useless.

dred years previously by the Dutch Administrator Burnand, and besides giving an immediate return as already stated, laid the foundations of the great development of cultivation in the Batticaloa district, a success which encouraged subsequent rulers to follow suit both there and elsewhere.

Sir H. Ward's departure from the Island at this juncture was undoubtedly a misfortune. Under his successor's easy rule, influences, which did not approve of his liberal expenditure, became paramount, and initiated a policy of economy which some went so far as to term "parsimonious." Disappointment was expressed at the return at Batticaloa not being as immediate or as large as expected; works were stopped there, and the "exigencies of the service" required Birch's return to his former appointment as a District Judge; and when he was entitled to promotion, he was sent to Sabaragamuwa. The officer, who then reverted to the assistant agency, in reporting on results, actually advanced as proof of the unfortunate results to the district, of his locum tenens' policy, that before the people always had a good store of paddy in their villages; but now they had got into the habit of selling it all for export to Jaffna, and had to buy rice for their consumption "in the winter," viz., the N.-E. Monsoon, when the port was closed and rice was high priced. But this was too much for Sir Charles MacCarthy, who replied that the Governor had, he feared, "studied political economy in a different school from the Assistant Agent."

Concurrently the *mot d'orde* was directed to increasing the collection of revenue* which affected agriculture in this wise.

When the considerate policy initiated by Turnour had established the success of the Commutation system, settlements were made for long terms, viz., 21 years (1840) in Nuwara Eliya, 25 years (1840) in Badulla, and similar periods in Kandy, Matale, with an allowance of 25 % for prompt payment. These voluntary agreements were based on a moderate pecuniary appraisement of paddy bearing a fair proportion to the probable cost of production, in fact a theoretical price, for there was then no buying or selling of paddy *for money* in Kandyan villages. When these agreements ran out in the fifties, the new industry, coffee planting, had necessitated the importation of a large foreign labour force, and to feed it *rice* had to be imported at a cost far exceeding the local cost of production of the same food of the indigenous population. The selling price of the foreign grain consequently fixed the market value of the village paddy, and undoubtedly the growers did sell some of their produce "on the estates" and elsewhere at the enhanced rate or even more. Though strong objection was taken to this many years after, such was the course contemplated by John Bailey, an admirer and follower of Turnour's working in 1858, and who anticipated a considerable advance in the amount of the Uva commutation in consequence of the value of paddy having then risen to 3 shillings "within reach of the estates" on the next revision due in 1860.

In Kandy, Matale and Nuwara Eliya the old agreements expired in 1856 when the price of rice in these districts was lower, and consequently the commutation for a bushel of Paddy was fixed at 1s. 4d. (say 64 cents) and less for the more outlying divisions). The result of this was a moderate advance from Rs.32,000 to Rs.45,000 for the term 1857-63.

Unfortunately for the "paddies" there was a considerable rise in the price of foreign rice about 1860. I see the Customs valuation of the imported paddy was increased from 75 cents per bushel in 1855-7 to Re. 1 in 1862, and of rice from 2 to 3 rupees. From a statement furnished to Ferguson's Directory for 1901, p. 142, I further gather rice was exceedingly dear in the Central Province both in the sixties and seventies.

In Badulla the agreements did not expire till 1860, and there was, it is stated, considerable delay in carrying out a new assessment, though various Assistant Agents pointed out the loss to the revenue by the delay (Mr. Fisher's report, p. 169), and the tax for 1861-2-3 was recovered on the old agreements. It was finally determined to have fresh assessments throughout the Province for seven years (1864-70) on the basis of the prices then prevailing; but in Uva, as the new registers could not be furnished till the end of 1865, authority was granted by Government to recover its share for 1864, on the particulars in the expiring registers as regards area and production, commuted at the new and increased prices for paddy determined on.

According to Mr. Fisher's report (p. 188, S.P. XVII of 1890) the value of the bushel

* Brodie declared about this time that the only proposal of his which met with the approval of the Colonial Secretary was an (ironical) one to sell the waste paper of the office and credit the proceeds to revenue, instead of leaving it as a perquisite of the peons!

of paddy for commutation purposes was taken in Uva from Rs. 1·33 to 1·50 cents in the outlying divisions, "where there was no market for the produce." He adds, "The Assistant Agent of Badulla protested against the great increase of the rates," but apparently he was not supported in his objection by Mr. Philip Braybrooke, who was at the time the head of the Province, and had himself served for some years in Uva and was a considerate, level-headed administrator. The whole matter was no doubt as usual considered in Executive Council, and as Mr. Fisher adds, "Government saw no reason to reduce the rates."

The point urged by Messrs. Christie, Fisher and Le Mesurier many years after that—because the paddy locally grown was consumed as food by the growers, and consequently did not find its way into the market—it should not be appraised by comparison with the market price of imported grain was probably not overlooked. But whether it was or not, the increase in the tax was the deliberate and well-considered action of Government, and in accordance with precedent and practice elsewhere, and justified by the prevailing prosperity of the people, who though they did not perhaps sell very much of their paddy, got a good market for their straw, the sale of which recouped a substantial portion of the outlay in the production of the crop.*

In Badulla there was undoubtedly revived activity in native agriculture under the influence of Bailey, who was Agent from 1854 to 1858, and doubtless anticipated the provisions of the first Irrigation Ordinance, as testified by Dr. Ondaatjie in "Notes on Badulla" published in the Asiatic Society's Journal (C. B.) for 1859 as follows:—"The extension of irrigation and the facilities provided for bringing waste land under cultivation and for the extensive production of paddy were due to the unremitting zeal of the last Assistant Agent." To the influence of the new Ordinance and favourable climatic conditions may, I think, be ascribed the excellent crops through the Central Province which average 1½ millions of bushels of paddy during the five years 1862-6.

With the increase in the rates of course there was a considerable advance all round in the collections. In Nuwara Eliya the demand went up in eight years from Rs. 6,200 to Rs. 24,000, and the advance in Matale was still greater, viz., Rs. 6,500 to Rs. 29,706. The Kandy district got off a little better, as it was only about *trebled*, viz., from Rs. 20,000 to Rs. 66,600.

In Uva the annual liability under the head Paddy commuted rose from Rs. 22,000 to Rs. 72,000 in round numbers, but the assessed area was increased by 1,000 ammunams (say 1,500 acres), and the estimate of gross produce by 60,000 bushels which accounts for 10 p. c. of the increase.

According to Mr. Le Mesurier "The general prosperity of the people at the time, the success of Coffee superadded to the fear of the renting system, made the people indifferent to these high rates, together with the idea that had got into their minds that the Commutation registers were registers of title."

So the tax continued to be commuted, and even where owners of fields had not done so, they paid it at the fixed commutation rates, by which they were probably gainers in view of the great increase of price of the grain which took place at this time.

In December, 1863, Sir Charles Macarthy was compelled to leave the Island owing to ill-health, and died at Spa in September of the following year. General O'Brien, Commander of the Forces, became ex-officio (as usual at that time) the Officer Administering the Government. He was an outspoken old soldier, and after a tour in parts of the island, spoke and wrote very plainly of the ill-conditions of the roads, etc. owing to the insufficiency of the vote for maintenance. The revenue had increased from £476,000 in 1855 to £953,000 in 1863; while the expenditure, which had risen to £705,000 in 1866, fell to £627,000 in 1862, and thus a surplus of £464,000 accumulated during 1861-2 and 3. Notwithstanding the flourishing state of the finances of the Island, all irrigation works were stopped, the roads badly required in the paddy districts, especially in Batticaloa were not provided, though the commutation assessments in the Central Province were *trebled*.

Eventually much of the results of this over-careful increasing of the finances by the strong man of the Government had to go to meet the natural demand of the Home Authorities for a larger contribution to the military expenditure in the island, viz., £100,000 as against the £24,000 hitherto paid into the "Queen's Chest." This led to a crisis in the Colonial Legislature and the resignation of the unofficial members (November, 1864).

* In parts of the Western Province the sale of the straw has met all the expenses of cultivation for at least the last fifty years.

Fortunately, at this juncture, in March, 1865, another strong man, Sir Hercules Robinson became Governor, a loosening of the purse strings immediately followed, and, though the revenue continued to increase (it topped the million pounds in 1869-70), expenditure kept pace with it, indeed in 1869 (the year of Mr. Gibson's retirement) the outgoings actually exceeded the incomings by nearly £50,000. Unexpended balances of annual votes for works were first re-voted in the Legislative Council in 1864; and after the question of military contribution had been settled, the Secretary of State granted permission in 1866 for the appropriation of surplus revenue on reproductive works without previous reference Home. A forward policy followed in all branches, and agriculture was happily fated to share in the golden shower, but an account of Sir H. Robinson's action in regard to irrigation marks a new era of developement, which will require a chapter to itself.

(*To be continued.*)

SOYA BEAN TRADE.

The Acting Commercial Attaché at the British Legation at Pekin reports as follows to the Foreign Office:—The extraordinary development of the export of the soya bean to Europe, which began in the autumn of 1908, received a decided check in 1910, the total shipments of beans decreasing by no less than 209,000 tons and bean cake 162,000 tons. This falling off was due to various causes—a short crop in 1909, high prices in Manchuria and the Yangtze Valley, a strong demand for bean cake for manuring purposes in South China, and the difficulties experienced by exporters in Manchuria in obtaining deliveries under their contracts. It should be noted that the customs returns from which the above figures are taken are for the calendar year, whereas the Manchurian bean season is reckoned from October to October.

The total export to Europe from Manchurian ports and Vladivostock during the season 1909-10 was actually greater than that of the previous season; Dalny and Vladivostock alone exporting 528,000 tons of beans as against 410,000 tons during the season 1908-09. His Majesty's Consul at Harbin reports that the 1910 crop was an excellent one, probably 20 to 30 per cent. larger than in 1909, and that the beans were a better quality giving, according to experiments made, a larger quantity of oil,

The bulk of the export of the soya bean from China still finds its way to the United Kingdom, but the recent decision of the Japanese customs authorities to refund the import duty on beans in the shape of a drawback on bean cake and bean oil exported, and the removal of the import duty on bean in Germany will probably result in largely increased shipments to those countries.

PLANT SANITATION.

INSECTICIDES AND FUNGICIDES.

INSECTICIDES FOR BITING INSECTS.

From a Bulletin entitled "Insects injurious to Citrus fruits and methods for combating them," published by the Porto Rico Agricultural Experiment Station, we extract the following which will be useful locally:—

PARIS GREEN.

Paris green cannot be used as effectively here as in the United States, on account of the heavy tropical showers which occur nearly every day during the rainy season. In some of the drier parts of the island this insecticide with air-slaked lime can be used with good results as a dust spray.

ARSENATE OF LEAD.

Arsenate of lead has been introduced, and at the present time it is taking the place of Paris green; it is not readily washed off by the rains, and it can also be used without any danger of burning the foliage. The formula is as follows:—

Arsenate of soda (50 per cent. strength) ...	... ounces	4
Acetate of lead ...	,,	11

Dissolve the arsenate of soda in 2 quarts of water and the acetate of lead in 4 quarts of water, using wooden vessels. Pour the solutions together and add 10 to 50 gallons of water. The white precipitate formed is arsenate of lead, which remains in very fine particles and is held in suspension much longer than Paris green. It can also be used with Bordeaux mixture or with kerosene emulsion.

ARSENITE OF LIME.

Formula for preparing white arsenite of lime is as follows:—

White arsenic ...	... pound	1
Crystal sal soda	... ,,	4
Water ...	... gallon	1

Mr Marlatt says:—Place the above ingredients in an iron vessel, which is to be kept exclusively for this purpose, and boil for 20 minutes or until dissolved. To 40 or 50 gallons of water a pint of this stock solution and 3 to 4 pounds of freshly-slaked lime are added. This excess of lime not only takes up any free arsenic, but by its distribution on the foliage enables one to determine how well the spraying has been done. This formula has been thoroughly tested and used now for many years, and is fully as efficient as any other arsenical and far cheaper. Chemically it is arsenite of lime. The soda is used to hasten the process and to insure the combination of all the arsenic with the lime. The greatest care should be exercised in preparing the stock mixture, and afterwards it should be plainly labelled to prevent its being mistaken for some other substance. The only objection to its use is the necessity of handling the poisons in its home preparation.

Insecticides for Sucking Insects.

A great number of contact poisons are being used in the island for destroying the various scale insects. Among the most promising are miscible oils, petroleum, kerosene emulsion, and lime-sulphur wash.

Many of the best emulsions have been condemned because they were not made exactly according to the formula. This has been especially true of the crude petroleum and kerosene emulsions. Not enough attention has been paid to the making of these emulsions. Often in ordering the ingredients the specifications are not clear, and as a consequence the goods that arrived are not just what were desired. Imperfect emulsions, in which the oil separates again from the water after being diluted, result from the use of hard water and from shortening the time required in mixing. Rain water should be used in making emulsions.

Miscible Oils.

Miscible oils are concentrated solutions of ingredients which have insecticidal properties to which it is simply necessary to add water to form the emulsion. They are usually handled commercially and have become one of the most promising scale destroyers. A manufactured miscible oil is used by some of the fruit growers with good results, having proved itself to be one of the best scale remedies that has yet been tried. The large growers cannot use it, however, as it is too expensive. Tests made here show that a strength of 1 to 25 not only destroys all the crawling young and those bearing the first covering, but also a great number of females with eggs. This emulsion has been used with good results on orange and grapefruit. At a strength of 1 to 20 some leaves dropped, but these were incrusted with scale or from badly infested branches. Home-made miscible oils were experimented with during 1908, and a number of formulas have been tried. The most promising are those made with crude petroleum and rosin oil. These give very stable emulsions and their destructive power is very high.

Miscible oils have many advantages over the kerosene and crude oil emulsions. After the soap is once made no more heat is required to make the stock emulsion or the various dilutions of the stock emulsion. Only one-third of the soap is heated and the other two-thirds is made up of kerosene and water. The time required for making the soap is about an hour.

If properly made they should not have any free oil on the surface when mixed with water. Emulsions made with kerosene do not require as much attention as those made with the heavier oils, such as rosin, paraffin, or crude oil.

On April 21, 1908, a number of experiments were made with the formula recommended in Bulletin 79 of the Delaware Agricultural Experiment Station. The trees were incrusted with scale at that time, but by March, 1909, they were absolutely free from scale. The scale did not immediately drop, but the trees have been cleaned by the rains and do not appear as if they would need spraying during the coming season. No ill-effects from these sprayings can be seen. The trees have had their usual amount of new growth and blossoms.

There is always a small percentage of leaves that drop, but they are usually the ones which have been covered with scale and have become weakened by the constant action of it. The loss of such leaves is not detrimental, as it is better that they be removed. Healthy, vigorous leaves are not injured. Similar results have been obtained with paraffin and crude oils.

These sprays should be applied with a nozzle that gives a very fine mist. The oils are very penetrating, and for this reason a smaller amount of emulsion is needed than of the old kerosene emulsion sprays.

Before the stock emulsion is taken from the barrel the whole mixture must

be thoroughly stirred, as the oils are liable to separate upon standing.

For stirring the emulsion a piece of board about 4½ feet long and 4 inches wide, to the base of which has been nailed a strip of board 10 inches long by 4 inches wide, has been found convenient. By using such a paddle the emulsion at the bottom of the barrel, which is thicker than that at the top, is raised and the whole mass becomes uniform. Is is always advisable to test the stock emulsion before taking any out for spraying. If any free oil is found add a little water, and after thoroughly stirring test it again. Continue this until a perfect emulsion is obtained. If this testing is not done, an emulsion with free oil is liable to be sprayed upon the trees, which will kill some of them. These emulsions are rather stable, and after one has determined the amount of water necessary to make a complete emulsion it very seldom varies. Where spraying is being done on an extensive scale the stock emulsion may be placed on the bottom of the spray tank and the water slowly added, stirring the whole until about half of the amount of water has been added, then the rest of the water may be added and the spraying begun.

The dilutions of all formulas have had to be changed, as all spraying in Porto Rico is done on trees with foliage. The dilution of crude oil formula set forth in Bulletin 40 of the Connecticut State Agricultural Experiment Station was changed from 1 to 15 to 1 to 25, the latter strength having exceptional killing powers. It not only kills the young purple scale, but also the females with eggs.

The same can be said of emulsions in which paraffin and kerosene oil are substituted for the crude oil. The Miscible emulsions made with heavier oils do not evaporate as quickly as those made with lighter oils, and for this reason their killing power is extended over a longer period. It has often been observed that the old scales seem to retain a certain amount of oil which is later on set free by the rains. This seems to be sufficiently strong to kill any crawling young whose mother has escaped being killed. The oil particles of these emulsions made with kerosene were so finely divided that they could not be seen with low powers of a compound microscope.

All the work done with these emulsions has been on young trees which were not fruiting. They will be tested on trees with fruit to determine whether they cause the young fruit to drop or whether they produce any discoloration.

Direction for making Miscible Oils.—There are three steps to be taken in making miscible oil emulsions before the emulsion for spraying is obtained. First, the cooking of the soap and the adding of the kerosene and water. Second, making the stock emulsion out of the soap solutions and various oils. Third, diluting the stock emulsion for spraying.

The soap solution should be made in the open air or under an open shed, as the mixture is inflammable when it reaches 300° F. It is also advisable to make the soap solution in a receptacle that is large enough to allow plenty of room for boiling. When the soap reaches 240° F. it begins to boil and continues to boil very violently until it reaches about 280° F. During this time the mixture foams and increases to at least double its volume. It is, therefore, very necessary that the receptacle be sufficiently large. When the soap reaches 300° F. it should be removed from the fire and the kerosene water added. First, pour the kerosene in slowly, thoroughly stirring the mixture; allow this to cool a little, then add the water. It is better to let it cool until the soap plus the kerosene is below 212° F. The following formula is used in making the soap solution:—

Menhaden oil	...	gallons	10
Carbolic acid	...	,,	8
Caustic potash	...	pounds	15
Heat to 300° F., and then: add			
Kerosene	...	gallons	14
Water	...	,,	22

In making the soap it is well to have the kettle covered with boards with a hole in the centre through which a thermometer can be placed to take the readings. It does not harm if the soap reaches 310 or 315° F., but it is not safe to continue the boiling after the soap has reached 300° F., as it is more liable to take fire. After the soap solution is completed, the fire can be drawn and the mixture placed in a barrel, after which the kerosene and water are added. The soap should be slightly ropy, but should run readily and not separate upon standing. A half-barrel of this soap has been left standing for six months without undergoing any change.

Stock emulsions are made by the following formula:—

Soap solution	...	gallons	8
Crude oil	...	,,	18
Rosin oil	...	,,	4
Water	...	,,	3

OR MORE IF NEEDED.

This formula does not state definitely the quantity of water necessary to obtain an emulsion free from oil, as the amount to be used often varies. After the stock emulsion has been thoroughly mixed try a few drops in a glass of water, and if no oil appears the emulsion is ready to be diluted with the water for spraying. It is recommended to use 1 gallon of the stock emulsion to 25 gallons of water for trees without fruit.

KEROSENE AND CRUDE-OIL EMULSIONS.

Kerosene emulsion was one of the first sprays to be used by the fruit growers on the island. The results from one spraying with a solution 1 to 5 parts of water have not been satisfactory, only the crawling young and those bearing the first covering being killed.

Crude oils have given better results. This oil does not evaporate as readily as the refined or lighter oils, therefore remaining on the trees for a longer period and killing more scale. A smaller percentage of oil is required in the crude-oil formula. These emulsions break down more quickly than the kerosene emulsions, and for this reason are not used to so great an extent. It has been shown by experiments that the destructive power of crude-oil emulsion, 1 to 15 or 18 parts of water is equal to that of kerosene emulsion 1 to 5.

While the price of these two oils is the same, kerosene makes a more expensive emulsion than the crude oil, as it is not so highly diluted, this difference in the cost of the two emulsions being about 1 cent per gallon.

KEROSENE EMULSION.

Kerosene emulsion made with whale-oil soap is one of the oldest insecticides in use. It is not as difficult to make as the crude and miscible oil emulsions. It is not, however, as effective in controlling scale, but as it is easily made and does not separate, it is still used by many fruit growers. The formula is as follows:—

Kerosene ...	gallons	2
Water ...	,,	1
Whale-oil soap	ounces	8

Put the kerosene oil in a spray pump. Dissolve the soap in the water by boiling and pour the solution into the oil; mix the whole by pumping for about 10 minutes, directing the stream back into the pump. If a large quantity of the emulsion is being made, it should be pumped longer. A creamy mixture should be obtained, which will hold up from two to three weeks

KEROSENE AND CRUDE-OIL EMULSIONS WITH CRUDE CARBOLIC ACID.

During 1908 crude carbolic acid was used in combination with both crude oil and kerosene emulsions. These emulsions were tested microscopically and appeared very different from the emulsions made without the crude carbolic acid. The oil particles are more finely divided, in some cases their diameter being only one-third to one-fourth the size of those in emulsions made without the carbolic acid. The killing power of these emulsions is greater than those made without carbolic acid, and they are more stable. Very little, if any, free oil could be found, even after the emulsion was allowed to stand several hours.

It seems quite possible that the carbolic acid will prove beneficial as a fungicide, but not to such an extent as the sulphur in the lime-sulphur mixture. Crude carbolic acid varies greatly in strength.

The formula for kerosene emulsion containing crude carbolic acid 100 per cent. (dark), is as follows:—

Kerosene	gallons	2
Water	,,	1
Whale-oil soap (hard)...	pound	½
or—		
Whale-oil soap (soft) ...	quart	1
Crude carbolic acid, 100 per cent. (dark) ...	pint	1

This emulsion should be made the same as kerosene emulsion. The carbolic acid is emulsified in the hot water with the soap.

Crude carbolic acid has been used in the various crude-oil sprays for ants, and the tests show that the amount of free oil which usually appears on these emulsions is practically eliminated.

CRUDE-PETROLEUM EMULSION WITH SAL SODA.

This formula has been used on trees which were infested with purple and white scales and sooty mold.

Crude petroleum ...	gallons	5
Water	,,	5
Whale-oil soap	pounds	2½
Sal soda...	,,	2

Place the oil in a barrel. Dissolve the soap and sal soda in boiling water. Mix the two by pumping back into the barrel for 15 to 20 minutes. Stock emulsions made according to this formula have given satisfactory results. Use one part stock solution to 15 parts of water.

LIME SULPHUR.

Lime sulphur is one of the few simple sprays which we have that has insecticidal and fungicidal properties, and for this reason it is becoming more and more popular. The only objectionable feature is the boiling which takes from 40 to 60 minutes. The formula is as follows:—

Fresh lime ...	... pounds	20
Flowers of sulphur ...	,,	15
Water ...	... gallons	60

Place the sulphur in an iron kettle and add 1 or 2 gallons of water, making the whole into a thick paste; heat, and when the mixture reaches the boiling point add the lime. Sufficient water must be added from time to time to slake the lime, after which the mixture is left to boil until it becomes a dark olive green; this generally takes from 40 to 60 minutes. After the mixture has been thoroughly boiled, sufficient water is added to make 15 gallons, then it is strained and the remaining 45 gallons of water are added. This water does not need to be heated, as the boiled portion of the spray contains sufficient heat to keep the mixture warm while it is being put on the trees. It should be applied warm, although good results have been obtained with cold lime-sulphur spray. In making large quantities of this mixture steam should be used for boiling.

Lime-sulphur spray was applied to two rows of orange, grape-fruit, and lemon trees in the experimental grove to compare the result with that from other sprays. This spray was made of 20 pounds of unslaked lime, 15 pounds sulphur, and 60 gallons water. All the crawling young scale and full-grown male scale and also a high percentage of females with eggs were found dead. This spraying was done on January 16, 1907, and eight days later no crawling young were found. The results with lime-sulphur are not equal to those obtained with the miscible oils made with kerosene, paraffin, or crude oil, but they are far superior to the results obtained with the kerosene emulsion. The cost of the lime-sulphur wash is about the same as that of miscible oils 1 to 20, but as it is advisable to use the oil 1 to 25, or in some cases 1 to 30, it makes the cost of the latter less than that of lime sulphur.

Lime sulphur is not only a good insecticide, it also has fungicidal properties. In groves where lime sulphur has been used there is practically no scale and very little rusty fruit. While this spray was used for the purple scale, it also held the rust mite in check.

Great care should be taken in applying a fungicide unless it contains some insecticidal properties. The various scales are preyed upon by beneficial fungi, which are sure to be killed by the fungicides; therefore it is recommended to apply an insecticide before or just after using a fungicide, so that the scale will not get so vigorous a start and injure the fruit; or it is still more practical to apply a spray which is in itself a fungicide and an insecticide. Lime sulphur seems to meet these two qualifications. This spray has at least two advantages over the oil emulsions; it remains on the trees and fruit for three to four months, and during this time seems to retain some of its beneficial properties. When it dries it is white, and thus one can readily see what part of the tree has been left unsprayed.

The fungicidal properties of lime sulphur do not remain on the trees as long as Bordeaux mixture. This has been observed in a grove where Bordeaux mixture was used, and the beneficial fungi did not begin to control the scale until after the first year. Lime sulphur was applied in the same grove, and at the end of six months beneficial fungi had established themselves and were checking the work of the scale.

CAUSTIC SODA AND SULPHUR WASH.

The following formula has been used extensively for red spider and rust mite in Florida:—

Flowers of sulphur	... pounds	20
Caustic soda, 98 per cent. ...	... ,,	10
Water ...	... gallons	20

For spraying use 2 gallons stock emulsion to 50 gallons of water. This strength kills the mite and spider, but not their eggs. Sulphur may be added to kerosene and crude-oil emulsions as a remedy for mite and red spider.

Although the ant is a biting insect, very unsatisfactory results have been obtained by the use of stomach poisons as ants will only eat the bait for a little while. By the use of contact poisons ants can however be combated. The following formula has been used with great success:—

Water	quart	1
Soap (Good's caustic potash or Fairbank's blue cloud soap ...	pound	$\frac{1}{2}$
Crude carbolic acid, 100 per cent. (dark) ...	pint	1

Dissolve the soap in water and add the crude carbolic acid, then add sufficient water to make 2 quarts. This should be used as a stock solution, using 1 pint of stock to 6 gallons of water.

BORDEAUX MIXTURE.

Bordeaux mixture is used in combination with arsenate of lead. In this way two sprays are applied at once—a stomach poison and a fungicide. This is far more economical and fully as good results are obtained as when the two sprays are used separately. The formula for Bordeaux mixture is as follows :—

Copper sulphate	...	pounds	4
Quicklime ...	...	,,	6
Water ...	...	gallons	50

Dissolve the copper sulphate in 25 gallons of water. This is very easily done by putting the copper sulphate in a bag which is suspended by a rope in a barrel; this enables one to determine if all the sulphate is dissolved. Slake the lime in a small amount of water, then add sufficient water to make 25 gallons. The two ingredients, copper sulphate and lime, may be used as a stock solution. For making Bordeaux, use equal parts of the two, pouring them into the spray tank at the same time.

Wooden vessels should be used for the mixing of the above, as Bordeaux mixture corrodes iron.

Stock solutions of Bordeaux mixture may be made by slaking 50 pounds of lime in a barrel and adding sufficient water, to make 25 gallons; then for each barrel of spray use 3 gallons of the lime mixture. In the same way dissolve 50 pounds copper sulphate in 25 gallons of water and use for each barrel of Bordeaux 2 gallons of this solution. To obtain the best results each of these solutions should be prepared separately with 25 gallons of water and then combined.

In spraying with Bordeaux mixture a pump with a good agitator is necessary, as the precipitate, which is a chemical union of the lime and copper has a tendency to settle. All parts of the pump should be made of brass, not iron.

HINTS ON PURCHASE OF INGREDIENTS.

Extreme care should be used in purchasing the ingredients for the soap and for the stock emulsions. There are a number of different grades of the various ingredients on the market, but from experience at this station and in the United States it is best to obtain the ingredients direct from large dealers and according to exact specifications. The following specifications and prices are quoted by New York firms :—

Pure menhaden, or fish oil, in barrel lots costs from 30 to 37 cents per gallon.

Caustic potash, 92 per cent. ground, can be purchased at 8 to 9 cents per pound by the hundredweight.

There are a number of grades of carbolic acid on the market which range from 20 to 100 per cent. The lower grades are not suitable for making the soap as they have a tendency to produce thick soaps, which do not emulsify the oils. The high-grade 100 per cent. crude carbolic acid, of straw colour, can be obtained for 40 to 45 cents per gallon in barrel lots. A 100 per cent. crude carbolic acid, dark, has also been obtained, which has given equally good results. This costs a few cents less per gallon than the straw colour.

Rosin oil is a vegetable oil obtained from the turpentine distilleries and costs from 23 to 26 cents per gallon in barrel lots.

SUMMARY.

The present condition of the citrus industry in Porto Rico is very promising. No insects are found in the groves that cannot be held in check by thorough treatment.

For biting insects, arsenate of lead is the best spray for the conditions that eixst on the island. Paris green does not have the adhesive power of the arsenate of lead.

Sprays containing oils are used for scale insects, but they will also keep the rust mite and red spider in check. However, where spraying is being done for the rust mite and red spider alone, it would be betterto use sulphur sprays.

The purple scale has been the worst enemy, but since windbreaks have been introduced, the beneficial fungi play a very important part in checking it.

The hemispherical scale and the Florida red scale are both held in check by the sprays used for the purple and white scales, and so is the white fly. It is very seldom that these insects need special treatment.

It is considered advisable to pick all the fruit before the new blossom growth starts, so that the sprayers may clean the trees well for the new crop. If the trees are thoroughly cleaned in this way, there is very little chance for the fruit to become scaly.

A great deal of the cultivated fruit has been disfigured either by fungi, mechanical bruises, or by insects. Special attention is called to the last

two causes of disfigured fruit. The insects causing the worst scars on fruit are the ants, small orange-leaf weevil, rust mites, and red spiders. The two last mentioned rust the fruit.

All these insects, however, are held in check by sprays described in this bulletin.

Mechanical injuries are caused by the fruit rubbing or hitting against some foreign object, as the leaves or branches.

EMULSIONS.

Of the various oil emulsions which have been introduced, the most promising are the miscible oils and the crude-petroleum and kerosene emulsions, the last two being made with crude carbolic acid, 100 per cent (dark).

At the present time miscible oils are recommended only for trees which have not come into bearing. No test has been made on trees with fruit. It may be possible to use these emulsions on trees with fruit by changing the formula, but when this is done a second and perhaps a third spraying will be necessary, as the high diluted spray kills only the young.

In purchasing materials for home made miscible oils great care should be exercised to obtain the exact ingredients called for in this bulletin. Home made miscible oils will not be practical for small planters, as the igredients in small lots are more expensive. They may be purchased, however, by an association, or a number of small planters may club together to purchase them.

For trees without fruit it is recommended that the small planters use kerosene or crude-oil emulsions made with 100 per cent. crude carbolic acid (either straw coloured or dark); use 1 to 5 for kerosene emulsion and 1 to 16 or 18 parts of water for crude oil for the purple and white scales, and repeat spraying in three weeks.

For trees in fruit use kerosene or crude-oil emulsions made with 100 per cent, crude carbolic acid (either straw coloured or dark); dilute them 1 to 8 or 1 to 25 parts of water, respectively, repeating the spraying every two weeks for four or five times.

Kerosene and crude-oil emulsions are greatly improved by the addition of a small amount of crude carbolic acid. When carbolic acid is used the oil particles are more finely divided and the emulsions are more uniform. This is especially true of crude-oil emulsion.

Emulsions made with sal soda are especially adapted to groves having an abundance of sooty mold. This fungus accompanies the Lecanium scale and the white fly.

Lime sulphur wash is the best combination for fungicide and insecticide. As an insecticide it is very valuable in combating the purple scale, red spider, and rust mite, and as a fungicide it is used for scab.

Great care should be exercised in applying fungicides, as they kill all the beneficial fungi which prey upon the various scales. At times fungicides have to be applied, but before using them the scale should be well under control; if not an insecticide should be used immediately after the fungicide.

TIME OF SPRAYING.

Spraying conditions in Porto Rico are very different from those in the United States. Many insects have no definite season of appearance. This is especially true of the scale insects. The constant appearing of the young makes the work of spraying more difficult. It is only by careful study and constant observation that one learns to recognize the condition of trees, and is able to determine at what time spraying is necessary.

Sometimes it is necessary to spray a crop of nearly mature fruit; this complicates matters, as a much weaker solution will have to be used than for trees without fruit.

There is no distinct blossoming season of the orange over the island, and the same may be said of the trees in individual groves. Some years there is a very scattering bloom, some trees being in full bloom, while others have not begun to show the blossom growth. The same trees will bloom one year in February and the next year in May or June. There are generally two periods of blooming, one in January and one in July.

The rainy and dry seasons occur at different times in different parts of the island. The Mayaguez district may be having its dry season while the Rio Piedras and Pueblo Viejo districts are having their wet season.

These varying conditions make it impossible to give hard and fast rules regarding the time of spraying.

When the fruit is the size of a pea almost any spray will injure the crop; thus spraying should be deferred until the fruit has reached the size of a walnut, as the fruits are then less liable to be injured by emulsions. A weak emulsion of kerosene 1 to 8 or 9, or crude

oil 1 to 25 should be used. As these are weak sprays, at least three to five sprayings will have to be given at intervals of two weeks in order to kill all the insects.

WINDBREAKS.

Windbreaks (Pls. IV and V) are as essential to a grove as a breakwater is to an open harbour. In groves which are thoroughly protected little, if any, spraying is needed for the purple and white scales, as the beneficial fungi, which thrive under moist conditions, hold the scale in check.

The mango gives the best permanent windbreak, and next to it comes the bamboo, which grows somewhat faster, but has no commercial value.

Temporary windbreaks are numerous, and among the best are those afforded by the pigeon pea and the various classes of bananas. Bananas produce a a very thick break in one year, and in this they excel the pigeon peas. Where trees are planted very close together the pigeon pea, which is a legume, should be used as a break.

SPRAY PUMPS.

The knapsack pump is the most convenient size for spraying very young trees. The barrel pump is the most popular among the planters of Porto Rico. As the groves are developing and more spraying becomes necessary, it will soon be more practical to use power sprayers.

With these more spray can be applied and at a less expense. At the present time some of the planters cannot cover their groves in less than three to four weeks, and where sulphur sprays are being used, with a repetition at intervals of two weeks, it is almost impossible to do thorough work, as the spraying outfits are inadequate.

THE MANGO WEEVIL.
(*Cryptorhynchus mangiferæ*, Fab.)

BY C. L. MARLATT,
Entomologist and Acting Chief in Absence of Chief.

(From the *United States Department of Agriculture*, Circular No. 141, June 20, 1911.)

The prospective mango industry of Florida is jeopardized. The mango weevil is likely to be introduced in the seeds of the mango. Shipments of mango seeds now coming to this country are largely infested with this weevil. Introductions of any mango seed or fruit into mango-growing districts are attended with the gravest danger. The precautions indicated in this circular should be strictly carried out.

The most serious insect pest of the mango in oriental countries is the mango weevil (*Cryptorhynchus mangiferæ*, Fab.) (fig. 1).* This weevil is related to the boll weevil and the chestnut weevil, and this, aside from its well-known destructive work on the mangoes, is sufficient indication of its undesirability. It is probably of Indian or at least of oriental origin, and has already obtained foothold in most of the important mango-growing countries, being carried readily with seed for planting. It now inhabits all of the mango regions bordering on the Indian Ocean and adjacent islands, and occurs throughout the East Indies, including the Philippines and other groups of South Pacific Islands. It has gained foothold similarly in South Africa and Madagascar and numerous other points. Fortunately this country is so far free from this pest, and if it can be kept out the mango industry which it is hoped to develop in Florida and perhaps in the other warmer parts of this country can be given a very great advantage over other mango-producing regions of the world. The insect in its different stages is illustrated, much enlarged, in figures 1 and 2,* from photographs by Mr. J. G. Sanders, formerly of this bureau.

As already indicated, this mango pest belongs to the weevil family. The egg is deposited in the fleshy part of the fruit, and the young grub (fig. 2, *a*)* burrows at once into the seed pod and develops in the seed to a pupa (fig. 2, *b*)* and finally to the adult, weevil, or beetle (fig. 1).* The green mango soon heals up over the egg slit, and there is very little, if any, exterior indication of infestation. The weevil or beetle is about one-fourth of an inch long and dark brown in colour. It remains in the seed for some time, and may thus be easily distributed with seed for planting or with the ripened fruit.

Protected as it is within the seed pod and, in fact, within the seed itself within the pod, it is not possible to destroy it by fumigation with any certainty. The only means of determining infestation is in opening the seed pod and removing the paper-like covering of the seed itself, when normally the gnawing and excrement and discolouration due to the work of the larvæ and weevil can be noted. Therefore all seeds introduced for planting in this country in regions where mangoes are grown should be opened in this manner and all that indicate infestation should be burned. As a matter of

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*Not reproduced.

further security all the apparently sound seeds should be germinated in a box under a wire screen, so that any weevils which may occur in seeds which show no visible sign of infestation may be retained and destroyed. The danger is particularly great where, as is now the case, mango seeds are being imported for planting in regions in Florida where fruiting mango trees occur. Where there are no mango trees, or trees of fruiting age, the danger is perhaps negligible, as no other food plant is known for the mango weevil. Still, if large numbers of these weevils should be introduced and liberated, they are long lived and might easily be carried on railway trains to regions where they might find lodgment. It is, therefore, desirable in any case to observe all the precautions indicated.

It has already been stated that this mango weevil is the principal enemy of the mango practically wherever this fruit is grown. In the Hawaiian Islands Mr. D. L. Van Dine, formerly entomologist of the Hawaii Agricultural Experiment Station, reports that during the first year of his examination he found 60 per cent. of the mangoes infested and the following year from 80 to 90 per cent., in some instances as many as four larvæ being found in a single seed. While the mango weevil destroys, primarily, the seed of this fruit, it is also believed by growers to hasten the maturity of infested fruit and thus increase the percentage of fallen mangoes.

Inasmuch as this insect passes its entire development within the seed, it is beyond the reach of insecticides and fumigation, and the only remedy which the bureau is able to advise to prevent it from becoming a pest in the United States is to collect and destroy all of the fallen or supposedly infested mangoes.

It is most urgently important now, however, for Florida to keep this weevil out. Mango seeds are now probably being imported into Florida by various growers, and the danger of such importation should be thoroughly understood, and whatever authority the State may have to prevent or control such importations should be put in operation.

Approved:

James Wilson,
Secretary of Agriculture.

Washington, D. C., May 23, 1911.

LIVE STOCK.

GERMANY.

Milk Supply in Large German Towns.

One of the most important questions for consumers in large towns is that of the Milk Supply. Not only does milk, with bread and meat, form the most important food of the whole population, but since it is the principal nutriment of children and of the sick, the possibility of an abundant supply of pure and cheap milk becomes not only an economic but also a social and sanitary problem deserving of every consideration.

Nor need we mention that, in these days in which the price of all foods has risen appreciably, the rise in price of milk, though perhaps less appreciable than in the case of other articles of foods, has yet occasioned much discontent and sometimes even strong protest on the part of the consumers. If this rise in price may be explained by the increased cost of cattle, forage, labour, etc., and that of carriage, since, as the cities grow, milk must be brought from more and more distant centres of production, yet it must not be forgotten that an important factor of the price is the gain of the middlemen.

Milk in its journey from the country producer to the town consumer passes generally through the hands of two or three dealers, each of whom naturally receives his appreciable profit. So, while the increased price is a burden on the consumer, it does not reach the pockets of the producers and is no gain to National agriculture.

It is therefore a wise policy for consumption to reduce to a minimum, if not altogether to eliminate, the work of the middlemen, and while this would be an economic gain, it would certainly be no loss from a sanitary point of view, as there would be no more superfluous and injurious manipulation of the milk.

It is, therefore, interesting to consider what is being done in the matter in Germany, where the problem is considered of such importance, that there has even been an agitation for a law to regulate the milk trade in a uniform manner and to guarantee its purity. We are helped in this study by the data given in an article in the August number

of the *Bulletin of Economic and Social Intelligence*, published by the International Institute of Agriculture.

First of all, we must observe that in some German towns the problem was to some extent solved by large establishments like those of Bolle at Berlin and Pfund Bros. at Dresden, whose large trade, immediate contact with the producers and scientific utilisation of waste products, permit of their selling at reasonable prices, while the very importance and the name of the establishments guarantee the purity and genuineness of the article. In 1909, the Bolle dairy alone sold 44 millions of litres of milk at 22 pf. the litre for unseparated milk, delivered at the dairy, and 24 pf. if delivered at the customer's house, that is 27 and 30 centimes respectively. The work of the Pfund dairy is only a little less important.

But if large establishments are already an appreciable gain, they tend too easily to become monopolies. Therefore, the co-operative organizations are of special interest, as they take the place of the middlemen, and in this way the profits are reaped directly by the consumers in the case of co-operative distributive societies, and by the farmers in the case of societies for production.

While 40 years ago the producers were quite isolated, the co-operative movement has made such rapid progress among them that in 1908 there were almost three thousand co-operative dairies in Germany, with about 260,000 members, which provide for the scientific supervision, preparation and treatment of the milk.

Quite half of these local co-operative societies already sell their milk directly, but their action, to be efficacious, must be integrated with that of the central dairies which have sufficient means and a large commercial organization.

In this way there have arisen *central dairies* in Berlin, Stuttgart, and Hamburg and other German towns. If some or these, and notably the two first, do not answer all the hopes raised by them, they yet exert a beneficent action in regulating the market, and setting a limit to the growth of monopolies, and some have given really brilliant results.

The most important of these associations as yet is that of Hamburg, which includes 25 co-operative societies with 2,800 members, and can dispose of the milk of quite 28,000 cows. Not without struggle has it succeeded in getting its strong position on the market by means of a wise system of prices overcoming the difficulties that opposed its progress, and becoming the chief supplier of the commercial co-operative societies and of the whole city of Hamburg.

In this way its annual sales have risen from 49 millions of litres in 1901-1902 to 63 millions in 1909-10, while the unsold milk, 13 millions of litres in the latter working year was made into cheese and other produce. The members of the society are, for the most part, owners of small or medium sized farms, who therefore directly profit by the economies and improvements of the assooication. It has been of appreciable benefit to them not only in respect to the sales, but also by means of assiduous technical and sanitary supervision, it encourages them to produce a better quality and, at the same time, a larger quantity.

(Summarised from the *Bulletin of Economic and Social Intelligence*, No. 8, Year 11, August 31st, 1911, published by the International Institute of Agriculture).

SWEDEN.

DEVELOPMENT OF LIVE STOCK INSURANCE IN SWEDEN.

In Sweden, Insurance of Livestock is carried on by 46 societies extending their operations over the whole country by 107 provincial and 552 cantonal or parochial societies.

The premiums paid yearly by the Swedish farmers for livestock insurance come to about 5 million francs, while the value of the cattle insured may be estimated at about 300 million frs. From an article on the subject in the August Number of the *Bulletin of Economic and Social Intelligence*, published by the *International Institute of Agriculture*, we learn that the largest number are insured in the "Scandinavian Livestock Insurance Society," with headquarters at Stockholm. In 1908, the amount of claims paid by this society was 1,636,184 frs., almost half of the total amount paid by all Swedish Livestock Societies.

In contrast with what is observed in several other countries, as, for example, France and Italy, where local mutual societies are most prominent, in Sweden it is the National Insurance Societies whose sphere of action is the whole Kingdom that insure the greater number of livestock. Suffice it to say that they insure 72 % of the horned cattle.

Two causes have specially contributed to the development of the large societies; the frequent fluctuations of mortality risks, the more dangerous for an insurance society in proportion as its sphere

of action is more limited; and the increase in the capital value represented by the livestock, by which the risk is increased and becomes less easy for local societies to support.

In the article mentioned we find all the insurance conditions of the Swedish Societies and detailed notices of the criteria the most important of them, the "Scandinavian Livestock Insurance Society" adopts in calculating premiums and settlement of claims.

This society has published interesting statistics of the mortality of the horses insured; for example, in the period 1891-1910, the average death rate of insured horses in Sweden was 2·38 per cent.

The data are grouped according to provinces, so as to show the influence of the various conditions of race, climate and agricultural labour. Thus, for example, in the province of Scania, where economic and meteorologic conditions resemble those of Denmark, the percentage of deaths is far above the general average for Sweden and nearly approaches that revealed by the Danish Insurance Societies (3·02 per cent.)

At the end of the article there is an examination of some analogies between human and animal mortality, made with the aid of Danish and Swedish tables, which has great interest also from a biological point of view.

(Summarised from the *Bulletin of Economic and Social Intelligence*, Year 11, N. 8, August 31st, 1911, published by the International Institute of Agriculture.)

THE SCOURGE OF THE TROPICS.

(From the *Tropical Life*, Vol. VII., No. 9, September, 1911.)

The depredations of termites in the Tropics and elsewhere are so widely recognized and their habits and methods of operation have been so closely investigated, that little remains to be said on these points. The question of efficient protection, however, is an ever-pressing problem in tropical countries, and many more or less controversial points appear to have arisen in this direction.

For the purpose of preserving wood from the attacks of white ants, numerous methods of treatment have been tried, and the reports thereon collected from independent sources appear to be of very varying character. For instance, we learn from an interesting article in the *Mindanao Herald* (*Philippine Isles*), for July 22nd last, that from certain official tests, which are now in progress in Formosa, it is found that woods treated with creosote are wholly free from attack by white ants. On the other hand, it has been long recognized, we understand, by Indian railway engineers, that creosote is of little or no value for protecting sleepers from these insects. Nor does there appear to be any consensus of opinion on the woods which are naturally immune from attack, as in some quarters it is maintained that termites will attack teakwood, whereas in others the reverse is reported. In searching for an effective method of treatment, consideration must be given as much to ease of transportation and application as to efficiency, particularly in those parts of the Tropics where the resources of civilization are not always available. Various well-known methods of treatment which may or may not give effective protection from termites are ill-adapted for tropical use, because they necessitate the transportation of the timber to some point where a special plant is available for carrying out the process.

The above-mentioned article goes on to emphasize the necessity of a special processing, indicating, that mere painting or dipping only insures a surface penetration. This, however, is a question which must be governed largely by circumstances. It is obvious that there are many cases in the Tropics where timber, whether for railway, building, or fencing purposes, cannot be treated with a process involving the use of special plant; and in such cases an efficient preservative solution applied with brushes or sprayers ensures much longer service in comparison with the life of untreated timber and amply justifies the cost of material and labour for the purpose. Where the circumstances allow of immersing the timber in the solution, in an open bath, however rough and ready, a higher degree of impregnation is of course obtained with a corresponding advantage in the life of the timber. Moreover, where large quantities of timber are being handled, the immersion method is certainly quicker and more economical.

The degree of impregnation to be obtained with any preservative solution is not so much dependent on the method of application as on the character of the wood and its condition at the time of treatment. It is obvious that a length of sapwood immersed in an open bath would absorb a greater quantity of solution than a similar length of heartwood cut from the same tree and treated under pressure, even though the process was carried so far as to injure the fibres.

It may fairly be advocated that any timber which is immersed in an open bath sufficiently to enable it to absorb approximately the maximum quantity of solution which it is capable of taking up by capillary attraction, is sufficiently impregnated for all practical purposes, provided, of course, that such timber is seasoned before treatment.

The requirements of an efficient wood preservative in the Tropics may be summarized as follows :—

(1) It must absolutely protect the timber from termites and other insects, fungus, and dry rot.

(2) It must be easy of application, either by immersion, painting, or spraying, so that woodwork *in situ* can be treated where necessary.

(3) It must be non-corrosive so as not to affect nails, spikes or other metal work brought into contact with it.

(4) It must be economical and preferably should be prepared in a highly concentrated form, capable of dilution on the spot, to reduce transportation charges to a minimum.

(5) It must *not* be inflammable, and preferably should be of such a nature as to render the wood more resistive to fire.

Doubtless there are many preservatives aiming at these requirements at present undergoing exhaustive tests in the Tropics, though up to date no one method appears to have met with general acceptance in all quarters. We notice, however, that the now fairly well-known Atlas treatment is gaining general favour in India and other termite infested countries, and appears to fulfil the above-mentioned requirements to a satisfactory degree.

SCIENTIFIC AGRICULTURE.

[This paper, though old, is perhaps worth reproduction, as showing the lines upon which a modern department goes to work to render scientific results available to the practical agriculturist.]

THE SCIENTIFIC DIRECTING OF A COUNTRY'S AGRICULTURE.

A Paper read before the Australasian Asssociation for the Advancement of Science, by A. N. Pearson. Victorian Chemist for Agriculture, etc.

One of the expressed objects of associations for the advancement of Science is the popularization of science; to quote the official words, it is "to obtain a more general attention to the objects of science, and a removal of any disadvantages of a public kind which may impede its progress." My chief object in writing this paper is to give from a scientific platform to the public some explanation of the methods and aims of scientific work in connection with agriculture. I need, therefore, make no apology for commencing this paper with an appeal to the public, to the men of affairs, and to those engaged in the actual practice and business of agriculture.

Permit me, first of all, to remove an ambiguity which may attach to my use of the word agriculture. This word may be used in two senses. In the wider sense it includes all pursuits whose object is to obtain produce from the soil whether that produce be in the form of animals pasturing on the land, or of crops grown in the soil. In a narrower sense the word agriculture refers to the growth of crops, and the pasture of animals on cultivated lands. I use the word in its widest sense as referring to all industries which have for their object to make all kinds of land bring forth their produce, both animal and vegetable.

I am profoundly impressed with the importance of the subject before us. In this country of Australia we are all engaged in the great and historic work of building up a new nation. It is mere truism to state that the future developments of this nation, its social evolution, the growth of its intellectual, moral, and spiritual forms, the vigour and activity of all which we call the higher life of a nation, will be determined in an important degree by the nature of the foundations we are now laying.

As a determining factor in the growth and life of a nation, it is difficult to over-estimate the importance of its agriculture. It is the agriculture which feeds the nation. In its lowest sense, of course, everyone will at once see this; the material basis of our life is the food we eat. But in a much wider and higher sense does this statement hold good; more especially in the case of countries such as the Australian colonies. Here by far, and away, the principal industries are those concerned in raising produce from the soil. Let us as an illustration take the concrete

case of the colony of Victoria in which we are assembled. From Mr. Fenton's statistical tables we are able to obtain the following figures concerning agricultural, mining and manufacturing industries of the colony in 1897 :—

AGRICULTURAL.

		Value. £
Crops		6,913,364
Live stock brought into consumption :—		
Cattle 219,436 @ £5 =	£1,097,180	
Sheep 1,920,295 @ £1 =	£1,920,295	
Pigs and Poultry (?)	£ 350,000	
		3,367,4765
Dairy produce		2,597,361
Wool		2,332,870
		£15,211,070

MINING.

Gold	£3,251,064
Other metals ...	10,337
Building stone, clay, earths, &c. ...	29,030
Coal	110,017
	£3,400,448

MANUFACTURING.

Foods, Drinks, &c.

	No. of Workers.
Chaff-cutting, &c. ...	810
Flour, oatmeal, maizena, &c., mills	911
Biscuit, jam, &c., factories	1,401
Confectionery and sugar works	908
Bacon-curing and meat freezing and preserving works	603
Butter and cheese factories	1,166
Soap and candle works ...	487
Brewing, malting, &c. ...	1,132
Aerated waters, &c., and ice	986
Coffee, cocoa, chicory, mustard	218
Tobacco and cigars ...	767
Textiles, Dress and Leather Goods.	
Woolwashing and tanning	1,891
Woollen mills ...	809
Tailoring, dressmaking, underclothing, millinery, hats and caps ...	11,072
Furs, waterproofs, umbrellas and dyeing ...	546
Boots and shoes ...	4,223
Saddlery and other leather goods	490
Rope, mat, sack &c., works	407
Building Materials, Wood Work, &c.	
Stone-cutting bricks, lime, cement and pottery ...	1,414
Saw-mills	1,131
Saw-moulding, joinery, cabinet-making, &c. ...	2,239
Bedding, blinds, looking-glasses	443
Cooperage, dairy implements, brushes, baskets, &c.	533
Engineering, Metal Work, &c.	
Agricultural implements	914
Engines, machinery, iron-founding, tools and nails	4,615
Railway engines and carriages, &c. ...	1,283
Carts, carriages, bicycles, &c.	1,418
Ship and boat repairing and building ...	132
Sheet-iron, tinning, brass work, &c.	897
Workers in gold, &c. ...	471
Unspecified	178
	44,488
Chemical, Electrical, &c.	
Gas and coke ...	668
Electric light and apparatus	178
Chemical, inks, oils, explosives, &c. ...	657
Glassworks, smelting &c.	445
Bone and manure mills ...	122
Miscellaneous.	
Stationery and paper mills	1,022
Printing	3,844
Unspecified	1,276
Total number of Workers ...	52,700

From this list of figures we get the value of produce from the land in 1897 as about 15¼ millions pounds sterling, whereas the total value of the mining industries did not amount to 3½ millions. These figures strikingly indicate the preponderating value to this country of its agriculture, yet they do not show this as emphatically as might be, for this reason, that whereas the gold obtained from the mines is appraised at its full ultimate value of £4 per ounce, the agricultural produce is taken in most cases at its wholesale value as raw material. But this is not the full value of agricultural produce. The final produce is not the cattle in the sale yards, but the butcher's meat delivered to the house; it is not the wheat in bags, but the loaf delivered by the baker. If the agricultural values were based upon

retail prices of the finished products as ready for the ultimate consumers, it is easy to see that we might have perhaps 30 millions sterling, instead of 15¼ millions, as in the above table.

In this way we can form some estimate of the comparative values of the agricultural and mining industries of the country. But what about the manufacturing industries? We are unable to present their value as so many pounds sterling; but the classified list of the manufacturing industries above given affords us a more instructive insight than such a bald valuation would do.

This list shows us the manufacturing industries under thirty-nine headings, and also shows the number of workers in each—the total number of workers being 52,700, Now, out of these different groups of manufacturing industries, the following, namely, (1) chaff-cutting, (2) flour and oatmeal, &c., mills, (3) biscuits, jam, &c., factories, (4) bacon and meat preserving works, (5) butter and cheese factories, (6) soap and candle works, (7) brewing and malting, (8) wool washing and tanning, (9) woollen mills, (10) boots and shoes, (11) saddlery, &c., (12) Sawmills, and (13) bone and manure mills obtain nearly all their raw material from the country's agriculture, that is to say, thirteen out of thirty-nine groups of industries, or one-third of the whole, are engaged in working up agricultural produce into forms suitable for the final consumers. The workers employed in these thirteen groups number 16,074, or again nearly one-third of the whole.

But in addition to these, several others, namely, the chicory, mustard and spice factories, the tailoring underclothing, and hat and cap factories, furs, ropes, saw-moulding, joinery, and cabinet-making, the cooperage, dairy implement, brush, and basket factories, cart factories, chemical works, paper mills, and unspecified obtain a portion of their raw material from the produce of the land. Hence we may estimate that out of the 52,700 manufacturing workers, fully 20,000 are engaged in working up agricultural raw material. There are about 128,000 workers directly employed on the land in agricultural pursuits, and if to these we add th 20,000 already mentioned, we get 148,000 engaged in agriculture and industries connected therewith. But what are the other 32,700 doing? Nine hundred and fourteen are making agricultural implements 1,283 are making railway engines and rolling-stock for carrying agricultural produce, or passengers largely doing business connected therewith, some thousands are making engines and machinery for cultural work or industries, others are making clothing, sugar, tobacco, and various other articles to be consumed by farmers and their families, or by people doing business in connection therewith.

In brief, all these manufacturing industries exist, either for the purpose of working up raw agricultural produce or in great part for supplying the needs of the agricultural population and of those working in industries, business, and professions ultimately dependent on agriculture.

These figures, then show, that, in the widest sense our national life is based on the produce of the land. It is the agriculture that feeds the railway, that feeds the industries, and that feeds the professional and business life of the cities.

Some may think I have spent too much time in bringing out this generally acknowledged fact. My experience has been that it is not a generally acknowledged fact, and that many who do acknowledge it do not fully realize its significance and importance. That half of the population which dwells in cities is especially prone to lose sight of this fact, and too often there grows up a sense of aloofness and of actual jealousy between the town and country, particularly in regard to the expenditure of public moneys.

It would be instructive if we could all trace our incomes to their ultimate source. The suburban tradesman—baker, butcher, grocer—supplies articles which are mainly of agricultural origin, to a number of families, the bread-winners of which are, in one case, a clerk in a bank which advances to city merchants, who supply country storekeepers, who in their turn give credit to farmers; in another case, a mechanic who helps to make machines which are used in the manufacture of agricultural implements, or of engines for country use; in a third case, the bread-winner is a reporter on the staff of a metropolitan journal. which is read by an agricultural population in the country, and by a population engaged in the city in business based ultimately on the agriculture of the country; in other cases the bread-winners are musicians, lawyers, doctors, clergymen, teachers, and so on, all of whom are engaged in serving a population whose business is based on the country's agriculture. I suppose that on the average fully two-thirds of every

man's income in this colony would be found to be derived, directly or indirectly, from the produce of the land.

I remember some years ago, in a lecture delivered before a farming audience, referring to an advertising placard which I had seen. The illustration was a homely one, but it will bear repetition even from a scientific platform. The placard contained a series of pictures. At the top was a picture of the Queen who rules over us all; underneath this were pictures of the soldier who fights for all; of the parson who prays for all; of the lawyer who pleads for all, and so on; and down at the bottom was a picture of a man following the plough, and under him was written—"The farmer who pays for all." No one in this community should lose sight of the fundamental truth indicated in this homely illustration. Every man, woman, and child is dependent for existence upon Mother Earth. Those occupations which have for their aim to make the earth bring forth her riches are at the foundation of our prosperity. Every citizen in the community is virtually concerned in the proper cultivation of the land. The more prosperous the agricultural community, the more numerous become the openings for men in other walks of life, and to raise the status of the agriculture is to raise the status of the whole nation.

Thus, in its widest sense, the nation is fed by its agriculture. Not only, however, in this wide sense, but also in a higher sense is this statement true. The moral and intellectual growth of a nation is largely determined by the conditions of its rural life. It is well recognised that the country and the city develop different qualities of character, and each brings into play special virtues and activities. Often the nimble thought of the city contemns the slow conservatism of the country, and pictures the farmer as the Bœotian type of stupidity and ignorance. How false is this picture, none know better than those who have had intimate acquaintance with the farming population. There are good men and indifferent in all walks of life, but there is no man fitted to command one's respect more than the first-class farmer, the man who has carved out his prosperity by persistent industrious toil on the land. The knowledge and insight such a man has derived from personal observation and contact with nature is astonishing, his readiness and resource are such as to put many of us to shame, and the freshness of his feelings, his hospitality and open-heartedness, come to the man of the world as a refreshing tonic. His conservatism is generally excessive caution taught by experience. The moral dignity of his calling is beyond question. Washington described agriculture as the noblest occupation of man. And read also what Emerson says:—

"The glory of the farmer is that, in the division of labours, it is his part to create. All trade rests at last on his primitive activity. He stands close to nature. His profession has in all eyes its ancient charm, standing nearest to God, the First Cause. He has grave trusts confided to him. In the great household of nature, the farmer stands at the door of the bread-room and weighs to each his loaf. It is for him to say whether men shall marry or not. He is the continuous benefactor. The farmer is a hoarded capital of health, as the farm is the capital of wealth, and it is from him that the health and power, moral and intellectual, of the cities came."

Perhaps the most pressing problem in our nation-building is the improvement of the conditions of country-life so as to encourage the growth of the country population, and to call forth the greatest number of men of this type. The country is the recruiting ground of the cities, and its best men are a perennial source of fresh vigour and impulse in a nation's life, a constant antidote to the selfishness and pessimism engendered by city strife and competition.

We thus, then, I trust, realize the high and preponderating importance in many senses of a country's agriculture.

Now, agriculture is not a science; it is a business. What then has science to do with it? And how should any one venture to speak of the scientific directing of a country's agriculture? Well, what is science?

It is really remarkable that, notwithstanding the wonderful growth during the last half-century in industrial development, in machinery, inventions, in discoveries, in the knowledge and practical utilization of the forces of nature, there are still men, even some of prominent positions and comparative education, who deny to science any practical value. On the other hand we have had academic statements that, in human affairs, science has little significance except for practical purposes. Notwithstanding such attacks on opposite sides, science is more and more justifying its position by the rapid improvement of its world-wide organization, the enormous swelling of its ranks, the increased volume of its output, and the ever-widening sphere of its activities. In these

colonies many men of practical affairs regard science as the fad of amateurs. The scientific man is to them a theorist, whose ideas are not based on the solid facts of experience, but are the bubbles of imagination blown from the lather of books. Science must not be held responsible for all that is said and done in the name of science: and even the best of scientific men are but men, with their share of the human liability to err. But science is not theorizing, and the scientific man will produce less theories in a life-time than the self-styled practical man will spin in a year. Huxley, in one of his apt phrases, described science as "trained common sense." The real meaning of science is knowledge, and surely no one will deny the practical usefulness of knowledge. Science is, however, something more than ordinary every-day knowledge. It is knowledge obtained by thorough and exhaustive examination of many facts by patient well-planned accurate experiments, and by unprejudiced logical thinking, as to the meaning of the facts thus brought to light. Its methods are those of common sense improved by training, discipline, and exercise. Science is not the exclusive property of the professional scientist, but is the common heritage of all men, and is free to every one who will enter it with open mind, industrious work, and honest thought. There are men in all ranks who are born with the scientific cast of mind, and the practical farmer, the man in business, the journalist, the legislator, and so on, may be men of scientific method and habit of thought. The more scientific men are in all walks of life, the more practical they are, and the less given to be guided by prejudice and imperfect knowledge.

The scientific directing of a country's agriculture means then the guiding of that agriculture according to knowledge and the dictates of common sense.

Now let us see something of what science can do for agriculture. Mr. Fenton, our Government Statist, has shown that in 1897 there were 3,260,312 acres of land under tillage in Victoria. Now, it is, as I have already indicated, very much to the interest of every citizen in this community to know what these 3¼ million acres of land are producing. Are they yielding to the country the best in quantity and quality that they might yield? As to quantity, their average yield of the four staple crops during the last eleven years was as follows:—

AVERAGE PRODUCE PER ACRE OF PRINCIPAL CROPS IN VICTORIA, 1888-1898.

Year ended March.	Wheat. Bushels.	Oats. Bushels.	Potatoes. Tons.	Hay. Tons.
1888 ...	10·81	22·92	4·11	1·41
1889 ...	7·10	14·20	3·04	·75
1890 ...	9·75	23·87	3·33	1·48
1891 ...	11·13	22·26	3·79	1·37
1892 ...	10·26	23·43	3·50	1·39
1893 ...	11·04	25·75	3·51	1·44
1894 ...	10·38	22·62	3·54	1·22
1895 ...	8·33	21·14	3·49	1·26
1896 ...	4·01	11·28	2·67	·84
1897 ...	4·49	16·25	3·37	1·08
1898 ...	6·38	16·35	1·52	1·14
Average ...	8·52	20·01	3·26	1·22

In Great Britain the averages during the same period were—Wheat, 29·49; Oats, 38·13; Potatoes, 5·85.

Here we see that our 3¼ million acres are producing an average of only 8½ bushels of wheat, 20 bushels of oats, 3¼ tons of potatoes, and 1¼ tons of hay. In Great Britain they produce three and a half times as much wheat from an acre of land as we do, twice as much oats, and one and four-fifth times as much potatoes. We cannot compare their hay returns with ours, because their hay is from meadow grass, whereas ours is from green oats and wheat. It may be argued that we cannot get as high average results here as in Great Britain, because our average climate is not so favourable. That is a conclusion I would not admit without discussion. Our southern districts, in some places, have almost ideal agricultural climates; and our northern districts, though they have drought and fierce summer heats, have their set off in the British Isles in the rigorous winters of the north.

But, making due allowance for climate, let us ask if our acres are producing all they might do if more science, that is to say, more correct knowledge, were imported into their cultivation. That climate is not responsible, for everything is proved by the fact that we sometimes may see 20 bushels of wheat on one farm and only 7 or 8 on an adjoining farm or 10 tons of potatoes per acre grown by one man and only 3 or 4 tons by his neighbour.

I have here a table giving a few results, culled out of many, obtained from field experiments carried out under my direction from time to time in various districts of Victoria

TABLE SHOWING A FEW RESULTS OF TEST PLOTS IN VICTORIA.

	Hay Port Fairy. Mr. Goldie. Mangolds.		Port Fairy. Mr. Ritchie. Potatoes.	Childers. Mr. Whelan. Potatoes.	Natimuk. Mr. McComas. Wheat.	Kerang. Mr. Patchell. Wheat. Irrigated.
	1889.	1892.	1893.	1890.	1896.	1893.
Plot.	tons.	tons.	tons.	tons.	bushels.	bushels.
1 Light dressing	$4\frac{1}{4}$	50	$3\frac{3}{5}$	4_{20}	$8\frac{2}{3}$	26
2 Medium dressing	$4\frac{5}{6}$	$65\frac{1}{4}$	$6\frac{1}{4}$	$5\frac{3}{4}$	$15\frac{1}{3}$	$32\frac{2}{3}$
3 No manure	$2\frac{2}{3}$	$14\frac{1}{4}$	$1\frac{11}{20}$	$3\frac{1}{6}$	$4\frac{2}{3}$	$18\frac{2}{3}$
4 Heavy dressing	$6\frac{1}{5}$	79	$5\frac{1}{11}$	7	$19\frac{1}{3}$	33
5 No nitrogen	$4\frac{5}{8}$	$65\frac{1}{10}$	$1\frac{3}{5}$	$4\frac{3}{4}$	14	$28\frac{2}{3}$
6 No phosphoric acid	$3\frac{3}{8}$	29	$\cdot\frac{3}{20}$	$3\frac{7}{8}$	$1\frac{1}{3}$	$22\frac{2}{3}$
7 No potash	5	63	$6\frac{1}{2}$	$5\frac{3}{8}$	18	$31\frac{1}{3}$
8 No manure	$2\frac{1}{2}$	16	$1\frac{3}{11}$	3	$2\frac{1}{3}$	12
9 Lime and same as 1	$5\frac{1}{8}$	38*	$5\frac{2}{5}$	...	$13\frac{1}{3}$	$23\frac{1}{8}$
10 Lime and same as 5	$4\frac{1}{4}$	73†	$2\frac{3}{4}$	...	...	15

* 20 tons farmyard manure. † 20 tons seaweed and 1 cwt. superphospate.

The facts shown in this table are of very great practical interest and importance. On plot 3 the corps were grown on the soils in their natural condition without the artificial addition of plant food. This is how the vast majority of crops in this colony are grown. Of the $3\frac{1}{4}$ million acres under cultivation, only about 226,000 acres, or one-fourteenth of the whole were manured in 1897. Now, in 1896 the average wheat yield of the colony was 4·01 bushels per acre. Turning to the experimental plots of wheat at Natimuk in that year we find that, on plot 3, the soil yielded $4\frac{2}{3}$ bushels per acre, or approximately the same as the average of the colony. That year was a year of drought, and the low, average yield of wheat was almost universally regarded as the maximum obtainable with such unfavourable climatic conditions. But let us look at the other plots. In that same year, plot 2 with a medium dressing of manure, yielded $15\frac{1}{3}$ bushels per acre, or three and a quarter times as much as the manured; and plot 4, with the heavy dressing, yielded $19\frac{1}{3}$ bushels, or four times as much as the unmanured. It was exceedingly interesting to see over 19 bushels of wheat per acre obtained at a time when many of the surrounding farmers had crops too poor to be worth harvesting.

The results from Kerang were also of special interest. A few years ago, when irrigation began to attract attention in this colony, it was found that the average yield of our irrigated wheat crops was only 13 bushels per acre. The gain due to irrigation was so slight that it generally did not repay the cost of the irrigation. Mr. Patchell, of Kerang, tested the effect of irrigation combined with manuring, and these figures show the result. The irrigated but unmanured soil on plot 3 yielded $18\frac{2}{3}$ bushels per acre. This was $5\frac{2}{3}$ bushels in excess of the colony's average of irrigated wheat, but still was nothing to boast of. On plots 2 and 4, which were manured as well as irrigated, he obtained 33 bushels per acre, a higher yield, in fact, than the English average. In a letter to me, Mr. Patchell explained that he was unable to irrigate these experimental plots sufficiently, owing to short supply of water; with more water he believed he could have obtained still better results, and very probably he could. I have under conditions of favorable rainfall obtained as high as 54 bushels per acre, and crops of even 70 bushels have been known.

Our table of test field results gives us no returns from oat crops, but let us turn to the potatoes. Here we see that in 1890 from plot 3, the untreated soil at Childers, Mr. Whelan obtained a crop of $3\frac{1}{6}$ tons per acre, that is to say, practically the same as the average for the whole colony, which in that year was $3\frac{1}{3}$ tons per acre. But from the two adjoining treated plots he obtained $5\frac{3}{4}$ tons and 7 tons respectively, there being in the latter case a gain of close on 4 tons due to the treatment of the soil. I may say that, during the last year

on some experimental crops at Kyneton, there was a gain of 5 tons due to similar treatment; and you will see from the table that in 1893, at Mr. Ritchie's Port Fairy plots also, there was a gain of 5 tons due to this treatment.

Now, let us turn to Mr. Goldie's hay results obtained at Port Fairy in 1889. His untreated soil on plot 3 yielded at the rate of $2\frac{3}{8}$ tons, which is double the average yield of the whole colony, both his soil and climate being much more favourable than the average. But look at the yields he obtained from the adjoining plots, in the one case $4\frac{5}{8}$ tons, and in the other $5\frac{1}{7}$ tons per acre. The latter was so much beyond ordinary experience that many people refused to accept it as correct. Mr. Goldie assured me that he himself was surprised at it, and took steps to confirm its correctness. I have during the last two or three months obtained $4\frac{1}{3}$ tons from an experimental plot at Werribee, and I am sure 4 tons might often be obtained.

Look also at Mr. Goldie's mangold results obtained in 1892. The untreated soil yielded at the rate of $14\frac{1}{4}$ tons, but the treated plots yielded on the one side four and a half times as much, namely, $65\frac{1}{4}$ tons, and on the other side five and a half times as much, namely, 79 tons. Plot 9 yielded 88 tons, and on one occasion Mr. Goldie forwarded returns showing as high as 103 tons per acre. I doubted the correctness of the last result, but only recently Mr. Goldie has, I understand, publicly harvested a crop yielding more than 100 tons per acre.

It is not possible to see returns like these without feeling that our lands are not producing anything near what they might produce if they were subjected to other treatment than that they now receive. For the sake of making a general statement, I have summarized the returns of ten of these experimental fields taken promiscuously, and, taking the yield of the untreated soil on plot 3 as 100 I have calculated the average improvement on the different plots. The following are the figures obtained:—

GENERAL AVERAGE OF RETURNS FROM TEN TEST FIELDS.

Quantity Plots.

Plot 1.	Complete manure, light dressing	..	181
,, 2.	,, medium ,,	..	259
,, 3.	No manure	..	100
,, 4.	Complete manure, heavy dressing	..	273

Quality Plots.

Plot 5.	Same as plot 2, but no nitrogen	..	207
,, 6.	,, ,, ,, phosphoric acid	...	110
,, 7.	,, ,, ,, potash	..	259
,, 8.	No manure	...	99

I do not claim that these ten fields were a fair sample of our $3\frac{1}{4}$ million cultivated acres; probably indeed, they were a trifle better than the average. These figures have no individual significance, they are merely a general statement. But they strongly suggested that, by applying more science, our soils could be made to yield more than twice as much as they are now yielding.

The facts brought out by these test fields are such as cannot be ignored. We cannot neglect them, or regard them as mere interesting curiosities. They are pregnant with suggestion of wealth and prosperity to the country. They show that we have in these colonies possibilities, vast possibilities, which, as a young nation, we have not yet seriously considered. It appears to me that the time has now arrived when we must consider them in earnest.

It will naturally be asked if the treatment which has resulted in these vastly improved yields could be practically applied in actual work. Would not the cost be too great? If the treatment could not be profitably applied, then the suggestion to adopt it would not be a scientific suggestion, for facts of profit and loss are as much data of science as any other facts. If it were the fact that results like these could not under present conditions be profitably obtained, we should not, however, for that reason ignore them, or shelve the whole matter as being outside the practical. It would be the business of science to experiment and investigate further, in order to find out how to bring them within the sphere of the profitable. As a matter of fact, however, they are already within that sphere. Presently I will endeavour to show this.

First, however, let me briefly explain the principles which underlie these field experiments. You will see that there is distinct method in these plots. They are scientifically planned. I wish to dwell on this point, because farmers sometimes carry out field experiments of their own, and on more than one occasion such experimenters have claimed for their tests the superior merit that they are not scientific experiments, but practical ones. Scientific experiments may be all very good in their way, and no doubt are, but what is wanted, say these men, is practical tests. And their idea of practical manure experiments is to buy as many as possible of the various trade manures offered in the market, to put an equal money value of each manure on to each

separate plot, and to see which plot gives the biggest yield. Time will not permit me now to indicate how utterly misleading and unpractical such experiments are. It would be easy to get all kinds of strange conclusions from such experimenting. For instance, here are the returns from nine plots in an experimental field harvested a few weeks ago:—

Plot 1	yielded	$20\frac{3}{4}$ lbs.	per plot.
„ 2	„	$37\frac{1}{4}$	„
„ 3	„	$29\frac{3}{8}$	„
„ 4	„	28	„
„ 5	„	27	„
„ 6	„	$27\frac{3}{4}$	„
„ 7	„	$30\frac{1}{8}$	„
„ 8	„	35	„
„ 9	„	21	„

The manure applied to each of the above plots had the same money value. Which, then, was the best manure? Clearly, we should say the one given to plot 2. As a matter of fact, however, each plot received identically the same manure. The truth is, none of the plots received any manure at all. The variations in the results were due to variations in the soil itself, or to some other accidental circumstances. Now, had we been manuring these plots on the principle of equal money values of trade manures, we might have by chance put an absolutely worthless manure on to plot 2; and what a splendid advertisement this experiment would have given to such a manure. By so-called "practical" experiments of this kind, numbers of farmers have been known actually to injure the crops on some of their plots by the wrong use of essentially valuable manures; and the anomalous result has occurred of their giving the palm to the least valuable fertilizer, on the ground that it did the least injury to the crops.

Now, a really practical manure experiment takes into account the nature of the food which plants require to feed upon, and it will be so planned as to find out if the soil experimented upon supplies enough of this food to insure the maximum growth of crop. As to which vendor's manures should be selected for carrying out the test is of no consequence whatever to the experiment. Preferably, on general grounds, one would choose the manure or manures which supplied the required plant foods at the lowest price and in the most available form.

Briefly, I may state that in practical agriculture it is found in general necessary to consider only three of the plant foods, namely, nitrogen, phosphoric acid, and potash. A mixture containing these three plant foods in standard proportions is called a complete manure. If from this mixture one or two of these constituents be omitted, or be given in considerably reduced proportions, then the quality of the manure is altered. Now, the experimental fields, the results of which I have presented to you, are laid out on such a plan as to furnish an answer to the two leading questions which have to be considered in practical agriculture, namely (1) How much manure is to be used? and (2) What kind?

Thus we have a plot which receives no manure, then we have a plot which receives one measure of manure, that we call the light dressing; another receives two measures of manure, that we call the medium dressing; then another receives three measures, and that we call the heavy dressing. These four plots give us a test as to the quantity of manure required. Thus referring to the figures on page 9, and comparing plot 1, which had the light dressing, with plot 3, the untreated soil, we find that one measure of complete manure has caused an increase of 81 per cent. in the crop. On plot 2, which had two meausres of complete manure, the additional measure has caused an additional 78 per cent. in the crop, that is to say, twice the quantity of manure has given practically twice the increase. Evidently then the whole of the medium dressing is required. On plot 4, however, which received three measures of manure, the third measure has caused an additional increase of only 14 per cent., and probably this small increase would not repay the cost of the manure required to produce it. With figures like this before us, we should say that the medium dressing was the one of maximum profit. These plots would then have shown us the quantity needed.

Then we have another set of plots in answer to the question as to the quality required. On plot 5 we give the same amount of phosphoric acid and potash as on plot 2, but we give no nitrogen. Now, if the soil can of itself supply enough nitrogen, plot 5 will yield as much as plot 2, and we shall naturally conclude then that nitrogen manuring is unnecessary. If, on the other hand, we get no better result off plot 5 than without any manure at all, we say that, all the nitrogen given on plot 2 is needed. If we get an intermediate result then we may conclude that only a portion of the nitrogen given on plot 2 is necessary. Plot 2, in the above-given returns, yielded an increase of 159 per cent., but plot 5, to which no nitrogen was given, yielded an increase of 107 per

cent. We should say that some nitrogen was necessary, but not the full dressing; probably one-third of the full dressing would have been enough. Similarly plot 6 shows us the requirements in respect of phosphoric acid. We see that without phosphoric acid there is practically no better result than with nothing at all—there is a gain of only 10 per cent., instead of 159 per cent. In such cases we need have no hesitation in assuming that all the phosphoric acid given on plot 2 is necessary. Plot 7, without potash, gives exactly the same result as plot 2 with potash. Clearly from such a result we may conclude that potash manuring is unnecessary.

Plot 8 is a duplicate unmanured plot. If it gives practically the same result as plot 3, we have confidence that the experiment has been properly carried out. If, however, the results of these duplicate plots do not agree within reasonable limits we shall place less reliance on the whole experiment. In such case the test must be carried out with greater care the next season.

A field experiment laid out on a plan such as this is a scientific experiment; and I think no one after following the explanation of it will deny it the merit of being practical.

We are now in a position to consider the question of the profitableness of results such as those quoted from the experimental fields. I have on several occasions shown that not only are they profitable, but that only with treatment of this kind can real profits in most cases be made. We will take the case of Mr. Whelan's experimental potato crop in 1890. Most farmers in this country simply make a living; from a business point of view they cannot be said to make a profit. If they were to charge for their labour at ordinary rates, and were to reckon interest on the capital value of their farms, it would be found that balance under present conditions was generally on the loss side. Thus, the net outcome of 3⅛ tons of potatoes produced on plot 3 of Mr. Whelan's experimental field would be as follows :—

	£.	s.	d.
Two ploughings and harrowings	1	4	0
Seed	1	0	0
Two hoeings	0	3	0
Earthing up	0	2	6
Harvesting.	1	15	0
Marketing	0	15	10
Interest on capital ...	1	5	0
Total cost	£6	5	4
Value of 3⅛ tons at 35*s*. per ton	5	10	10
Loss	£0	14	8

Now, compare this with the result obtained on plot 4. This plot received a dressing of 54 lbs. nitrogen per acre, 90 lbs. phosphoric acid, and 66 lbs. potash. An examination of the results from the different plots shows that all this was not necessary. The full amount of phosphoric acid was required, but only half the nitrogen and one-third the potash. This mixture would at present be most cheaply purchased in the following form:—

	£.	s.	d.
144 lbs. sulphate of ammonia at 12*s*. 6*d*. per cwt ...	0	14	4
193 lbs. concentrated superphosphate at 12*s*. 6*d*. per cwt.	1	1	6
37 lbs. potash chloride at 13*s*. 6*d*. per cwt. ...	0	4	6
	£2	0	4
Freight and application	0	4	6
	£2	5	0

The financial result then comes out as follows :—

	£.	s.	d.
Two ploughings and harrowings	1	4	0
Seed	1	0	0
Two hoeings	0	3	0
Earthing up	0	2	6
Harvesting	2	0	0
Marketing	1	15	0
Manuring	2	5	0
Interest on capital ...	1	5	0
Total cost ...	£9	14	6
Value of 7 tons potatoes at 35*s*. per ton	12	5	0
Profit ...	£2	10	6

By adopting a suitable system of rotation of crops, a still greater profit could be obtained; for there are certain crops, namely peas, beans, clover, cow peas, soy-beans, crimson clover, lupines and other of the leguminosæ, which have the valuable quality of causing the soil to be enriched in nitrogen from the air. By introducing these crops into a rotation, the cost of the nitrogen manuring, amounting in the above case to 14s. 4d., may be saved. By that means the profit could be raised to £3 4s. 10d. per acre a sufficiently handsome result, we imagine to satisfy both the farmer and the financial institutions which have to aid him.

The above result, however, does not represent all the profit. There is still more to come; for it has been many times demonstrated that the whole of the manure is not used up in the first season of application. Under the most favourable conditions only about two-

thirds of it are used up by the first crop; there may be, indeed, only one-half or one-third of it used. The rest remains in the ground in the great part for the use of subsequent crops. This is shown clearly enough in the following results obtained by Mr. John Goldie, at Port Fairy. A dressing of manure was given in 1889, and the crops obtained in 1890 and 1891 were as follows:—

		Mangolds—1890. per acre. tons.	cwt.		Wheat—1891. per acre. bushels.
Plot 1	...	29	10	...	33½
,, 2	...	41	14	...	42
,, 3	...	21	14	...	28
,, 4	...	44	4	...	44⅔
,, 5	...	39	10	...	39⅓
,, 6	...	27	6	...	30⅓
,, 7	...	44	11	...	38⅓
,, 8	...	19	10	...	28⅔

Here we find on plot 7, as compared with plot 8 an increase of 25 tons of mangolds and 10 bushels of wheat. If the mangolds are valued at the very low rate of only 5s. per ton, and the wheat at only 2s. per bushel, this was a gain of £7 5s. per acre. The cost of the manure in this case would have amounted to only £1 9s. per acre.

We may conclude this section with one or more illustration. The problem of profitable manuring in our dry northern districts, where the great bulk of our wheat is grown, has presented certain difficulties which have been overcome only by several years' experimental work. In the earliest attempts it was found that the crops were often seriously injured by the application of fertilizers to the land. The manured crops made remarkable growth in their early stages, while there was plenty of moisture in the soil; but afterwards, when the hot dry weather set in, they dried up. The farmers concluded that the manures were of a scorching nature, and caused the crop to be burnt up. The truth was that the crops made such prolific growth in their early stages that they rapidly used up the scanty store of soil moisture, and in their later stages, when their large size gave them a correspondingly large need of moisture, there was less soil moisture left for them. They consequently died off for want of water. The manures were used only in light dressings, as ideas of light dressings went in those days. But it takes time to climb down from notions of tons to the acre. It is not much more than a generation ago since an application of 10 tons of manure to the acre was regarded in the old country as a light dressing. With improvement in knowledge it has been found possible to make artificial fertilizers of such quality that 5 or 6 cwt. of them would go as far as 10 tons of the old bulky stuff. But in our dry districts we regarded 5 cwt. as a heavy dressing, and came down to 2 cwt., 1½ cwt. and 1 cwt. Still we had not gone far enough. My attention was first directed to the possibility of getting out of the cwts., and using only a few lbs. to the acre, by the experience of one of our Victorian wheat-growers, Mr. Salter, who dipped his seed wheat while it was wet from the pickling tub into superphosphate, and thereby got a few pounds of the material to stick to the seed. He believed he obtained substantial benefit thereby. Several farmers, hearing of his experiments, tried his method, with I believe, on the whole, favourable results.

Last year I carried out experiments in a dry wheat district with much smaller quantities of manure than I had ever before used, going down to as little as 10 lbs. to the acre. The following results have been received from Mr. Telford, of Mount Pleasant, St. Arnaud:—

WHEAT ON FALLOW LAND. SOWN 25TH APRIL, REAPED 29TH DECEMBER, 1899.

	Yield per acre.	Bushels per acre gained by Manure.	Value of increase at 2s. per bushel. s. d.	Cost of Manure per acre. s. d.	Net gain or loss to farmer. s. d.	Gross gain to the country at 2s. 6d. per bushel. s. d.
Board Plot	12·73	—	—	—	—	—
1. 10 lbs. concentrated superphosphate	16·46	3·84	7 8	1 1½	6 6½	9 7
2. No manure	12·51	—	—	—	—	—
3. 20 lbs. concentrated superphosphate	18·22	6·00	12 0	2 3	9 9	15 0
4. 30 lbs. concentrated superphosphate	18·22	6·29	12 7	3 4½	9 3½	15 9
5. No manure	11·63	—	—	—	—	—
6. 26 lbs. ordinary superphosphate	15·58	3·58	7 2	1 2	6 0	8 11
7. 26 lbs. Thomas' phosphate ...	13·84	1·47	2 11	1 2	1 9	3 8
8. No. manure	12·73	—	—	—	—	—

Only two days ago I received from Jeparit, a drier district than St. Arnaud, still more striking results. The treatment of the plots was the same as at St. Arnaud, and the following were the returns from the first five plots :—

Plot	1	2.	3.	4.	5.
Bushels per acre	7·90	3·84	13·60	14·93	3·84
Gain due to manure	4·06	—	9·76	11·09	—

To our forefathers a result such as that would have appeared incredible. To them 10 tons would have been a light dressing. Now we speak of 10 lbs. as a light dressing; and the experiment shows that 30 lbs. was a heavy one. By the expenditure of only 13½d. in manure the produce was raised in value by nearly 10s. per acre. To me it appears that this is one of the victories of science; a victory which may not indeed capture the imagination, but which in the near future may be worth some millions sterling to these colonies.

But the addition of artificial plant food to the soil is only one of the methods by which the land may be made to yield more produce. Improved methods of tillage are able to produce remarkable improvements in the growth of crops. On this subject whole treatises have been written, and it is not my intention now to enter into details; but we should probably not be far out if we were to state that by improved tillage alone, without manuring at all, the average of the wheat yields of this colony might be raised at least 50 per cent. Tillage operates in many ways, but in our dry districts its most important operation is that of a water conserver. In districts which receive 25 or 30 inches of rain annually, 2 or 3 inches more or less is not counted very much; but where there are only 10 or 12 inches a year, every inch has to be regarded as of great value. What is the real value of an inch of rain? Has this question ever been seriously considered? One inch of rain per acre, if it were all used in the growth of wheat, and none of it wasted, would produce 5 bushels, and 10 inches would produce 50 bushels. What is done with the rain which falls on the land? The answer is that it is lost. Nine-tenths of it is allowed to evaporate again into the air uselessly. The soil should be a storage reservoir for this moisture, keeping it locked up until required for use. So badly, however, is this storage managed that only about one-tenth of the rainfall is put to use. How to make use of that wasted nine-tenths is one of the problems science has to investigate on behalf of agriculture. In part this matter has been already investigated, and it was some years ago demonstrated by the American experimenters that the loss of moisture by evaporation from the soil was appreciably less if the soil was kept stirred by the cultivator or harrow. Thus, at the Storr Agricultural Station, evaporation in sixteen days during the summer was found to be as follows :—

		Heavy Soil. Inches.	Light Soil. Inches.
Not stirred	...	1·66	1·31
Surface stirred	...	1·26	0·69
Saving of moisture due to cultivation	...	0·40	0·62

There was in only two weeks a saving in one case of two-fifths of an inch of the wasted rainfall, which was equal to 2 bushels of wheat per acre, and in the other case three-fifths of an inch, or equal to three bushels of wheat. This fact explains why harrowing a young wheat crop, or hoeing between the drills, should have been found by those who have tried it to be beneficial. This is a matter which requires further experiment and demonstration; and it appears to me one of the most promising lines of investigation which may ultimately result in greater practical benefit than a costly system of irrigation.

But attention to the soil as regards supply of either plant food or moisture, is not the only method of increasing our agricultural wealth. It has for a long time been known that considerable differences exist in the prolificness of seed, not only of seed obtained from the same field or crop, but also of seed from the same plant. Thus Burbidge, in his "Cultivated Plants, their Propagation and Improvement," quotes elaborately obtained results from both German and English experimenters. Dr. Gustav Mark, at the experiment station of Halle and Leipsic, conducted experiments in the growth of beans and peas from large and small seed, and measured and recorded the development of the plants in minute detail. The plants from the larger seed were of more uniform growth, of earlier development, produced heavier crops, and a greater proportion of good grain to inferior. The following table gives the yield of grain from ten plants of each kind :—

Beans.	From large seed.	From small seed.	Advantage of large seed over small.
Yielded grain of 1st quality ...	162	121	—
Yielded grain of 2nd quality ...	6	25	—
Total grain ...	168	146	15 per cent.
Peas.			
Yielded grain of 1st quality ...	48·5	19	—
Yielded grain of 2nd quality ...	19·0	37	—
Total grain ...	67·5	56	21 per cent.

In 1891, in connection with the work of the Intercolonial Rust in Wheat Conference, I carried out an extensive series of experiments, selecting in a variety of ways nearly 10,000 seeds of wheat, each of which was sown separately in holes one foot apart, in a specially prepared seed bed. An extended summary of this very labourious series of experiments was published in the third report of the Conference. The following short table shows some of the results obtained:—

TABLE SHOWING DIFFERENCE IN PROLIFICNESS OF DIFFERENT GRAIN FROM THE SAME WHEAT PLANT.

Description of Seed Sown.	No. of Seeds sown.	Grain harvested from every 100 Seeds sown.	Advantage of more prolific Seed in percentages of less prolific.
		oz.	per cent.
Large seed weighing more than 3·5 grammes per 100 seeds ...	393	29·4	21
Small seed weighing less than 3·5 grammes per 100 seeds	476	24·3	—
Seeds from large heads containing more than 80 seeds	434	29·4	25
Seed from small heads containing less than 80 seeds	435	23·5	—
Large seed weighing more than 3·5 grammes per 100 from large heads	218	32·7	29
Small seeds weighing less than 3·5 grammes per 100 from large heads	175	25·4	—
Large seed weighing more than 3·5 grammes per 100 from small heads	216	26·7	20
Small seed weighing less than 3·5 grammes per 100 from small heads	260	22·3	—
Large seed from large heads	218	32·7	47
Small seed from small heads	260	22·3	—

From this table it will be seen that the large seed gave 21 per cent. more grain at harvest time than the small seed, and that the seed taken from large heads of wheat yielded 25 per cent. more than the seed taken from small heads. The large seed taken from the large heads only was 25 per cent. more prolific than the mixed sample of all kinds, large and small together. Dr. Cobb, of New South Wales, has more recently experimented on similar lines with similar results. In some cases I continued my experiments through three generations of wheat plants, selecting always the best seed from the best heads of the best plants, and obtained thereby a marked improvement in the prolificness and general qualities of the wheat. At Sir J. B. Lawes' experiment station at Rothamsted, there was grown in one plot, eight years in succession, Hallett's original red wheat. The average yield of this for the eight years was 36 bushels per acre. On another plot there was grown under similar conditions Rivett's derived wheat. This yielded for the eight years an average of 53 bushels per acre, or 47 per cent. more than the original. These are striking illustrations of what can be done by simple selection of seed.

In 1892 I suggested the establishment of a system of seed selecting stations in Victoria for the perennial distribution of improved seed of all kinds to the different agricultural districts, but though I pleaded hard for their establishment, it was impossible to persuade the "practical" men that there was anything in the proposal. As a public protest against the reception given to this proposal, I resigned my connection with the Rust in Wheat Conference, a body the success of whose work depended mainly upon the selection and distribution of suitable seed.

I will conclude this list of illustrations by quoting some figures from a prize essay on potato-culture, written by Mr. G. Maw, of Brenthall, in England, and published more than thirty years ago by the Royal Agricultural Society of

England. This essay gave results of an extended series of experiments in potato-planting, conducted in 1864 and 1865. Amongst many other results were the following. Potato sets of different sizes, varying from 1 oz. to 8 oz., were planted at distances of 1 foot, in rows 2 feet apart. The following results were obtained :—

	Late Varieties.			Early Varieties.		
Sets.	Average of—	Yield per acre.		Average of—	Yield per acre.	
oz.		tons.	cwts.		tons.	cwt.
1	13 varieties	11	0	7 varieties	9	4
2	13 ,,	12	15½	7 ,,	10	14½
4	12 ,,	15	17½	6 ,,	13	9
6	9 ,,	20	6¼	6 ,,	15	6
8	6 ,,	23	8¼	2 ,,	7	17

In this country the rejected unmarketable potatoes are often, if not generally, regarded as good enough for seed; hence we do not get yields of 16, 20, and 23 tons per acre, but an average of 3¼ tons.

This must conclude my list of illustrations of what science can do for agriculture. I have confined these illustrations to such as show how we can materially increase the quantity of produce raised from the land by means of attention to plant food, moisture, and seed. And, indeed, this at present is the fundamental task before us, a task which overshadows all others; but, as every one acquainted with the subject knows, we might have drawn illustrations from every branch of agricultural practice. The improvement of our pasture lands, the cultural improvement of our native grasses, the improvement of our quality of our agricultural produce, more especially in regard to its value as food for man and beast, the improvement of live stock, especially of dairy herds, improvements in labour-saving appliances, improvements in attacking diseases and pests which prey on both plants and animals, improvements in factories and in processes for working up raw material, improvements in marketing methods, more especially as to export, improvements in social methods and organizations, all these present a most fertile field for the operations of that knowledge and trained common sense which we call science; and I have no hesitation in saying that, if all that science has discovered and has demonstrated to be practicable were being now applied to our agriculture in these various directions, the total annual wealth of this colony would be double of what it is at present.

How then are we to bring about this result? How are we to get this knowledge applied? How is the agriculture of a country to be brought under the control of science? This, at present, is not a question of agriculture, but rather a problem in practical psychology. It is mainly a question of getting new ideas into the minds of men. Some may call it a question of technical education, but it is much more than that. It is a matter of getting a whole nation to feel the gravity of these facts, and of rousing the people into action. It is not simply a matter of driving new knowledge into the dense mind of a farmer. The farmer is not so stupid as he is sometimes made out to be. Once demonstrate to him that these facts are really facts, and that they are practicable and profitable, and his own self-interest will make him apply them so far as he can. The average farmer is not a genius, and he has his own hard work to attend to, and he cannot spare time or money to put to the test every new notion which may be preached to him. Probably in his early days he has tried some, and failed to get any good out of them, and has grown suspicious of all the rest. But I have never yet found a farmer who could not recognise a profitable fact when it was presented to him with patience and tact, and by good practical demonstration. As a rule, farmers welcome and respect any man whom they feel to be a real friend with genuinely valuable knowledge to convey to them. But there is a great deal to be done besides coming into vital touch with the farmer's mind. What is wanted for the people is the country to recognise that this is a really great work, and a work of pressing importance, which needs adequate provision for its due execution.

As to the measures necessary for carrying out this work, we cannot now go into details. A good deal is now being done and has been done, with a reasonable amount of success. But much more is required :—

We may consider the requirements under two needs, namely :—

(*a*) Measures for acquiring knowledge.

(*b*) Measures for applying knowledge.

I shall not indicate all these measures, but merely some, the need of which I have specially felt.

Soil Survey.

In regard to measures for acquiring knowledge, one of the first things necessary is a comprehensive and detailed examination of the lands from which the country's wealth is derived, A farmer with a large farm of varied soils will have a plan of his farm, showing the paddocks and the distribution of the various classes of soil. And treating the whole country as a large and varied farm, one of the first essentials as a matter of practical business is to make a complete soil survey, to produce a soil map and compile an agricultural register of the country. Such a work when carried out would make it possible to issue to every farmer practical information concerning the agricultural value of his land, the kind of cultivation most suitable, and the proper method of treatment in order to get the maximum profitable produce.

In conducting this soil survey, note would have to be taken of the geography and climate of every farm, of the natural vegetation, of the mode of cultivation already adopted, and the results obtained. Test fields, such as I have already described, would have to be established; and, after the fields had served their purpose, excavations would have to be made in the unmanured plots down to a depth of 5 feet, more or less, with a view of determining the natural moisture and subsoil conditions, and for taking samples for analysis and for museum purposes.

With the aid of this map and register, and all the information gathered in connection therewith, and of annual inspections throughout the country, and of statistics, it would be possible to see year by year which districts were falling behind a reasonable average in the produce of their different crops, to inquire into the causes, and to suggest practicable steps for improvement. The soil map and register would also serve as a basis for the preparation of other special maps showing distribution of crops, vines, fruits, pasture, live stock, and so forth.

The carrying out of a systematic soil survey in this colony was proposed by me in 1891; and something of the kind was suggested several years ago by the late Mr. Cosmo Newbery.

Experiment Stations.

The next important essential is the establishment of permanent experiment stations. Every country has its own agricultural problems which require experimental research; and, although in these new countries we can make use of much of the general knowledge obtained at the numerous experiment stations of Europe and America, yet our local conditions present us with difficulties which we must work out for ourselves. The object of this experiment station is to investigate difficulties of this kind, and generally to make useful discoveries for agricultural practice. The problems to be worked out at these stations are numerous and varied, such, for instance, as the value of drainage, of different kinds of tillage, of different forms of plant food; the improvement of native plants, especially pasture grasses; the treatment of diseases and insect pests, both of plants and animals; the determination of food values, and so forth. At these stations also new agricultural implements are tried, and their merits and demerits determined. Experimental factories also are sometimes established at these stations for the preliminary trial or perfection of new industrial processes. These stations serve also as distributing centres for improved seed. Their work is wholly distinct from teaching, and although they may be established in connection with colleges, they need to be under separate management, In Victoria we need four of these stations to meet our different climatic conditions.

Systematic Examination of Produce.

A third essential is the systematic inspection and examination by analysis and otherwise of the various products of agriculture with a view to comparison as a whole with those of other countries and in detail between the produce of our different districts, so that steps may be taken for effecting improvement in the backward districts. Such work is already to some extent carried out by country inspections and by examination of exported produce.

As to the measures for distributing and applying knowledge, these are largely matters of general education and instruction, which do not call for special observation now. Four distinct kinds of work are required according to whether it has reference to children at school, youths in training, adults in practice, or the general community.

As regards children, much has already been said and written about introducing into primary schools simple lessons conveying a few salient facts of agriculture. I will not add anything to this, except in regard to one matter. Successful oversight of the work of a country depends much upon the use of statistical returns. These statistical returns need

to be reliable, and it is a moral duty of citizenship to furnish accurate returns. If some idea of this moral responsibility could be implanted in children's minds when they are impressionable, the gain would be great.

As regards the conveying of new ideas to adults, there is no method more successful than that of practical demonstration in the field and factory. A farmer may hear something at a lecture or read it in a book, but he does not believe it. Show it to him, however, as an actual fact before his eyes, and he cannot escape it. The system of demonstration fields has been most developed in France, where it was, I believe, first started. There they have three classes of these fields; the first are small plots a few yards square at the primary schools in country districts; the second are larger sets of plots, like the test plots in Victoria, of the results of which I havs already given you several illustrations—these are laid out on the farmers' land, the farmers themselves helping in the work; and the third are large fields of some acres in extent, which the farmers lend for the purpose of being worked for two or three years in succession, under the direction of Government professors of agriculture, the Government undertaking to pay the farmer any difference which may exist on the debit side between the returns of these fields and those of his farm worked in his own way. Such repayments never have to be made, the balance being always on the good side. These fields, it is said, have already resulted in great improvement of backward districts.

As regards the demonstration fields of the second class, there is now in Victoria a large and increasing demand for them; we shall have probably nearly 300 applications for their establishment during the coming season, and it will tax all our energies to get them started. The fact that we have so many applications for these fields, and that such interest is being taken in them shows that at last we are getting into touch with the farmers and are getting right to the heart of our difficulties. The fields, besides fullfilling their immediate use as demonstrations to the farmers, serve also the double purpose of the test fields required in the soil survey of the country.

Now, what I have said has been a mere sketch, a sketch in fragments. But I have endeavoured to paint it in bold and striking outline, so that the attention of the public may be attracted to the matter, and that they may realize that this work we have in hand is a really great work, and one which needs to be entered upon in the spirit of greatness.

Just a few words as to the men and machinery for carrying out this great work, and then I have finished. It is unnecessary to say that the work is such as can be carried out only by the State, and the Government departments which undertake it should be recognised as the most reproductive of all the departments, and second to none in importance. Those who direct the work need to be the best men obtainable; men with a thorough knowledge of their business, men of courage, integrity, tact, enthusiasm, energy, executive ability and untiring industry and love of work. There are such men already in the departments of these colonies, men of whom I think no country need be ashamed, who are able to make good use of opportunity, and to give the country real service. If one-half of what I have endeavoured to demonstrate in this paper be true, then these are men with vast possibilities in their hands, they carry grave responsibilities, and it is to the advantage of the country that they should be treated as such.

The proper housing of such a State department is a by no means subordinate detail. Every facility for the rapid transaction of business, and for easy reference and consultation amongst the principal officers, should be regarded as important and essential. The headquarters of the department should be a central building, designed specially for the purpose, having, besides other accommodation, first-class laboratories for chemical, bacteriological, botanical, entomological, and other work, a well-equipped library for the common use of the department, and a central museum. There is nothing unreasonable in this proposition, it is simply what is needed, and what will have to be if the work is to be properly organized and to result in the highest success.

With this I must conclude. Attacking the problem, as we may now do, with all the spring and energy and hopefulness of a nation in its youth, we should reasonably look forward to organizing a system of work, which taking advantage of the experiences of other countries, incorporating their good features, while avoiding as far as possible their weakness, should, by its operations during only a few years, practically double the wealth of these countries, effect great improvements in the conditions of rural life, and increase the strength and stability of the nation.

THE VALUE OF SCIENTIFIC RESEARCH AND THE PLANTERS' CO-OPERATION.

(From *Tropical Life*, Vol. VII., No. 9, September, 1911.)

In the *Planters' Chronicle*, the official organ of the U. P. A. of Southern India, there appears a report of an address by Mr. Rudolph Anstead which is well worth studying, and for more than one reason.

In the first place stress is laid on the necessity for adequate research work and field work in Southern India, where Mr. Anstead has for two years been established as Scientific Officer and Adviser to the U. P. A. S. I. The remarks he makes in the course of that address are applicable to Planters' Associations the world over, and not only to Planters Associations, but wherever agriculture is carried on.

There can be no reasonable doubt that money properly spent in devising better methods and in pointing the way for better results in crop raising confers a benefit on planters and agriculturists generally which cannot be calculated.

A well-ordered scientific department, such as exists in many countries, is practically a necessity if the best results are to be obtained. But there are two further points to be insisted on, first, that such departments shall not be starved financially; and, secondly, that the members of the Association or community for whose benefit the scientific department is intended should give all the assistance they can to those in charge of it.

With regard to the first point—finance—we need hardly discuss it, for if a thing is worth doing at all it is worth doing well, otherwise it is better left alone. And in this connection Mr. Anstead instances the recent vote of some £3,500,000 made by the U. S. Government for the Agricultural Department. Anyone who has studied the question in the United States cannot help agreeing with the Minister for Agriculture that the result of the expenditure of that Department—undoubtedly the best equipped in the world—has conferred benefits on the agricultural community which cannot be measured in £. s. d.

It is necessary, therefore, in the first place that cultivators should not grudge the necessary contribution for the proper upkeep of a scientific department.*

As Mr. Anstead remarks, they will reap the benefit several times over. But while adequate funds must inevitably be the first consideration, much of the benefit will be lost unless planters co-operate among themselves and with their adviser in energetically carrying out field experiments, &c., on their own land.

There is nothing like a practical experiment carried out, under scientific supervision, of course, on one's own land, and in many cases the procedure is so simple that there is little need to encroach too much on the adviser's time.

For instance, Mr. Anstead informed the Association that in Coorg an application of nitrate of soda to the Ceara rubber tree just before tapping had given good results in increasing the flow of the latex. He added that he would like to see the method tried systematically over a large area. Here is a chance for the planters to co-operate! It is quite a simple matter to apply, say, half a pound of nitrate of soda per tree over a small area on each plantation and compare the results with those obtained on a similar area without the nitrate. The results would be of immense value, not only scientifically, but to each individual planter.

There are, of course, many other ways in which the planters themselves could obtain valuable information, and at the same time be assisting their adviser by carrying out simple experiments on particular crops in given districts, and we only mention this one because the subject is mentioned in Mr. Anstead's address, and again because it seems so easily carried out. Further than this, we referred in our issue of March, 1910, p. 33, to the good results which had been obtained by similar experiments made by Mr. E. V. Wilcox, special agent in charge of the experiment station in Hawaii. In his report Mr. Wilcox gives minute details of several experiments, which in many cases resulted in the flow of the latex being *doubled* by the application of nitrate of soda.

* For this reason we were sorry to hear that the Agricultural Department at the Bahamas has ceased to exist. Although the work done cost money, the expenses never seemed excessive, and her agricultural industries are so important to the Bahamas that we should have thought it best to curtail expenses on anything else but this department, by which alone the Islanders can learn how best to make the most of their opportunities of trading with the outer world.

Mr. Wilcox concludes his report by a general appeal to planters "to determine the exact economy of the method by applying it on a large scale as soon as rubber trees become mature."

It is sincerely to be hoped that planters will realize how much depends, even scientifically, on their own efforts, and as Mr. Anstead rather pathetically remarks, not leave *all* the lecturing, &c., to be done by the scientific adviser. It is to be feared that in many Planters' Associations too much attention is paid to matters of perhaps lesser importance to the detriment of the most important question of all, viz., practical and scientific *planting*.

We have issued two pamphlets on this and other matters referring to the manuring of rubber trees, and shall be pleased to forward copies free to any of our readers desiring them. A postcard addressed to our City Office, 112, Fenchurch Street, London, E.C., giving the full names and address to which the pamphlets are to be sent, will receive immediate attention.

BUSINESSMEN'S LECTURE COURSE.

INTEREST BEING MANIFESTED BY THOSE OF EVERY NATIONALITY—WHAT SCIENTISTS WILL PRESENT.

(From the *Manila Bulletin*, September 12, 1911.)

As the date of the first lecture of the Bureau of Science series approaches, considerable interest is being manifested by businessmen of every nationality in this plan by which Dr. Paul C. Freer, Director of the Bureau, working with the Manila Merchants' Association is seeking to give to the men engaged in industry here some idea of what the scientist can do to aid the businessman.

Now that the Allied Chambers of commerce commitees has completed the arrangements for the lectures and the members of the committee are working to insure a large audience at the Empire theatre, September 19, this department of the Government is more in the public eye than ever before, and many questions as to the probable scope of the lectures have been asked.

To start the course, Dr. Freer will tell of the work of the bureau which he directs and its worth to the businessman. It is only in the last two decades that the scientist has begun to come into his own, according to recent writers, who comment upon the extension of science and scientific method even down to the shovel of the labourer and the trowel of the bricklayer. To-day scarcely a business exists which is not based upon science, or deals with materials in whose manufacture science has played a most important part.

The Philippines Bureau of Science has opened up a new field, in that it has had to deal with products of the tropics that had never been investigated by the scientist before in many cases and where preliminary work had been done in other countries, it was often found that erroneous conceptions had arisen which the Philippine scientist had to correct. One of these latter cases was that in which the greatest authority on vegetable oils stated that coconut oil was extremely liable to rancidity, and that it was impossible to keep it without changes in its composition taking place. This statement was tested by one of the experts of the bureau who found that coconut oil made from fresh, pure copra remained practically unchanged for two years, and that the proneness to rancidity which the foreign scientist had endowed it with was due to impurities in the copra and not the fault of the oil which never had been pure.

Many other similar cases where the Philippine investigator has set the chemists of other countries right can be found in chemical literature. The practical importance of such work as that above quoted can hardly be estimated, experts say, since it has pointed out the way to avoid enormous losses that can be prevented.

Following the lecture of Dr. Freer will come one on Philippine Alcohols by Dr. H. D. Gibbs, who has recently published an exhaustive summary of work he has been doing with plant juices which supply material for Philippine distilleries. In the course of these investigations, Dr. Gibbs found that the Philippine islands naturally possessed the cheapest source of alcohol in the world, but that the same nipa palm produces a saccharine fluid which needs only to be concentrated and crystallized to be sugar of commerce, equal in taste and grade to the best product of the cane and best sugar factories. As the crushing of the canes and extraction of the juice requires the most costly part of the sugar mill's equipment, this great expenditure is done away with by nature in the nipa palm's case where the juice trickles from the cut end of the flower stalk and needs merely be collected and evaporated to become marketable sugar.

In its work on coals, the bureau of science as set a new standard for judging the value, and has compiled tables which make the work of the coal chemists much more accessible, since it renders the comparison of values an easy matter. A lecture on the coals of the Philippines is included in the series.

Sugar, one of the four great exports of the islands, will be treated in a separate lecture which will make accessible to every one who attends, knowledge of the exact status of the industry and what is being done to extend and improve this product. Mines and Mining, Roads and Roadbuilding materials, Salt production in the Philippines which will point out ways whereby the islands can improve the processes and stop importations, are among the lectures to be given.

One of the chief aims of the lecturers will be to present their subjects in a popular manner without going into technicalities and making the information which the bureau has gathered during the last decade available for every businessman according to his needs. It is believed that this series of lectures and the plan of throwing open the resources of the scientist to the businessman gives the merchants of Manila advantage that is not provided in any country of the globe.

THE DEVELOPMENT GRANT FOR AGRICULTURAL RESEARCH.

(From the *Gardeners' Chronicle*, No. 1,289, Vol. L., Sept. 9, 1911.)

The scheme of the Board of Agriculture for the endowment of agricultural research has secured the approval of the Development Commissioners and the sanction of the Treasury. The official scheme, concerning which details were published in these pages last week, contemplates the expenditure of a considerable sum of money up to the maximum of £50,000 per annum.

The principles which the Board proposes to adopt in the expenditure of this research grant deserve the attention of all interested in agriculture and horticulture. Broadly speaking, these principles are the systematisation of research and the co-ordination of research-work in the several branches of agricultural science.

Hitherto, the scientific investigation of agricultural problems has been in large measure casual. Here and there men of ability have taken up this or that question and have tackled it single-handed, sometimes with conspicuou success. Such successes as have been achieved have been due in the main to the practical rather than to the scientific agriculturists, though honourable exceptions must be made in favour of the continuous investigations of the scientific staff of the Rothamsted Experiment Station, and also with respect to the younger institution, the Agricultural Department of the University of Cambridge. That the scientific agriculturist has not yet made many deep and abiding impressions on agricultural practice is not matter for surprise. Agriculture is not only the premier but also the oldest industry. All sorts and conditions of men are engaged in this art, and the ablest of these men have not been slow to discover ways in which the practice of agriculture may be ameliorated. The scientific expert, on the other hand, has had fewer opportunities, largely the result of insufficient financial support and the pressure of multifarious duties; only too often he is expected to devote a considerable number of hours to the laborious work of teaching, to go round the country as a sort of travelling farmer's friend, offering advice which is not always wanted and may occasionally be inaccurate, and in the remainder of his time it is fatuously expected that this expert shall make discoveries which shall revolutionise agriculture. To expect any such thing is sheer nonsense. What was to be expected was what has happened, namely, that such research as has been carried to a successful issue has been, with certain exceptions, both casual and sporadic. The scheme of the Board of Agriculture represents an attempt to reform this state of affairs.

In the first place money is available. In the second place, and yet more important, men are to be found if it is possible to find them. At the present time the number of investigators who are occupying themselves with agricultural problems is but small. The harvest—to be reaped—truly is plentiful, but the labourers are few. To remedy this fatal defect the scheme of the Board proposes the establishment of a certain number of scholarships for the express purpose of training students to the work of agricultural research. Each scholarship is to be of the value of £150, and to be tenable for three years at one of a number of approved institutions. There can be no doubt that this system of scholarships is an essential condition for the success of the attempt to develop agricultural research. At the risk of hurting susceptibilities, it is necessary to be explicit at this import-

ant stage in the history of agriculture, and to say that the body of men necessary for carrying out the scheme of research contemplated by the Board does not exist. The men have to be discovered and trained before the scheme as a whole can be developed.

We think that the Board are to be congratulated in thus recognising the need for the provision of recruits to the very small standing army of agricultural researchers, and we believe that they will find themselves spending more money on this subject than they at present contemplate, or that people impatient for immediate results will think necessary. In the meantime, while the scholarship holders are in training, grants are to be made to those institutions which are in a position to undertake agricultural investigations. Experience shows that institutions are able, under the stimulus of prospective grants, to improvise any amount of such capacity. The Board will, therefore, safeguard themselves and the public money in the following manner. Agricultural science is divided for the purposes of the scheme into a number of sections, namely, plant physiology, agricultural zoology, animal and plant nutrition, and soil problems, genetics (animal and plant-breeding), pathology (diseases of animals and plants), dairying, fruit-growing, and the economies of agriculture.

Each of these subjects is to be "farmed out" to one or more institutions in which are workers who have specialised in the subject. The advantages of this method of giving out research piecework are great, but there are also grave disadvantages attaching to it. The advantages are that the even development of several branches of agriculture is encouraged, and that certain of these branches are not neglected for studies which are at the moment more in fashion. Groups of workers will be encouraged by this system to co-operate toward the solution of those "borderline" problems of which agriculture presents so many problems which stand on the no-man's land which bound such sciences as botany and zoology. The disadvantages are that the scheme prevents over-lapping, and over-lapping in research is an excellent thing. It tends, moreover, to make each agricultural research institution too much of the nature of a technical institute for the investigation of one department of agriculture. We shall have soil institutes, genetics, institutss, dairy institutes, and so on. It is true that freedom is thriftless, and, therefore, not apt to find favour with Boards or Treasuries; but it is equally true that without freedom the best kind of research is likely to remain undone. The weak point of the scheme would appear to be that it makes no provision for one or more agricultural universities—places where agriculture is studied from a research point of view in all its branches, and where soil men meet with dairy men and genetics is cheek by jowl with pathology.

Nevertheless, the scheme will, we think, command the general approval and support of all friends of agriculture and horticulture. It represents an attempt to provide what is greatly needed—a body of highly-trained and efficient experts, who will devote themselves both to the investigation of agricultural problems and to the dissemination of knowledge of value to the farming community. It leaves the work of mere demonstration on one side and divides research into two sections: one general or universal, the other—and no less important—local. If successful, then in ten years' time we shall have in this country a group of men who are not only discovering the best methods of growing plant and rearing animals, but who are able to go to this field or that orchard and tell the grower who wants help what kind of permanent pasture, what combination of manures, and what remedial measures against disease he is bound to adopt if he is to secure the best results from his labours.

AGRICULTURAL FINANCE AND CO-OPERATION.

HOLLAND.

1. ACCIDENT INSURANCE AND THE FARMERS.

For various reasons there is as yet no law in Holland on Insurance against Accidents in Agricultural Labour, corresponding with that passed in 1907 against Accident in Manufacturing Labour. The want has, however, been supplied by the Farmers' themselves, efficiently assisted by the "State Commission for Agriculture."

In this way, there have arisen two remarkable organizations for this insurance. They are dealt with in an

article in the August Number of the *Bulletin of Economic and Social Institute of Agriculture.*

The first, founded in 1910, is the "Horticulturists' Mutual Society against Professional Risks." On the 1st January, 1910, it had already 2,392 members, whose wages amounted to 3,192,689 florins (equal to 6,651,010 frs.)

The second and more powerful organiztion began working on the 1st January, 1910, under the name of the "Farmers' Mutual Society." It is divided into local and provincial mutual societies, with a Central Society in Amsterdam. While the two former classes undertake direct insurance, the Central acts as their Re-insurance Society.

In case of accidents, the society pays the doctor, except in cases of small importance, for which there is no compensation.

If there is complete disablement, compensation is calculated at 75 % of the wages; in case of only partial disablements, the compensation given is less, and its amount is fixed for the first two months by the local commission and afterwards by the Central Management. An arbitration commission composed of employers and labourers settles disputes.

The insured pay an annual contribution varying from ¾ % to 2 % of their wages, in addition to an entrance fee paid by the employer, and also calculated on the wage: 3 florins (16·25 Fr.) for wages above 1½ florin (Fr. 3·125), 1½ fl. (Fr. 3·125) for wages between 1½ fl. (Fr. 3·125) and ½ fl. (Fr. 1·042) and 1 florin for those under ½ fl. (Fr. 1·042).

The results of the "Farmers' Mutual Society" have been excellent; suffice it to say that on the 31st May, 1911, that is, after hardly a year and a half of work, it had already 7,839 members, whose wages were 11,460,878 florins (equal to 23,875,301 Fr.).

2. INVALIDITY AND OLD AGE INSURANCE.

Last May a Bill was introduced into the Dutch Parliament for Invalidity and Old Age Pensions. This bill, though not the first dealing with this difficult subject in Holland—for it had been preceded by others in 1902, 1905 and 1907—is of remarkable interest for its completeness and its technical character. We reproduce some details from the last *Bulelin of Social and Economic Intelligence*, published by the *International Institute of Agriculture* (Rome, 31st August).

The Dutch Bill proposes the compulsory insurance of all those who have been employed in paid labour for sixteen years.

For the purposes of insurance, the workmen are divided into five classes, according as their annual wages amounts to 240, 400, 600, 900 florins (equal to 500, 833, 1,250 and 1,875 francs), or more.

The premium, to be paid every week, is fixed according to the class of the workman at 0·20, 0·24, 0·32, 0·40, or 0·48 florins (0·42, 0·50, 0·67, 0·83, 1·00 fr.).

Half is paid by the workman and half by the employer. The workman's half may be paid by the employer out of his wage.

In case of *disablement* the workman always has a right to pension, even if the disablement is only temporary, but in any case not lasting less than six months.

Old age pensions are due to all those who have completed twenty years and have paid 1,248 weekly premiums.

By the Bill the pensions are calculated: On the basis of the total amount of premiums paid by the insured, multiplied by 325 and divided by the number of weeks from the day the workman began insuring: to the result 10 % of the total amount of premiums paid is added.

The provisions in this bill for *Orphans'* pensions are also worthy of note. These can be claimed by children of less than thirteen years at the death of an insured parent (father or widowed mother) with claim to pension.

While imposing the above system of compulsory insurance, the bill allows of voluntary insurance with the State Insurance Bank for more highly paid workmen, desirous of larger pensions, or for those for whom insurance is not compulsory.

As a contribution to the expenses, especially high at the beginning, the Government should give a subsidy of 5½ million florins (17,708,200 Fr.) for a period of 75 years; by no means a small sum, but well spent when we consider that the number of the compulsorily insured would be about 1,330,000 persons.

(Summarised from the *Bulletin of Social and Economic Intelligence*, No. 8, Year 11, August 31st, 1911, published by the International Institute of Agriculture.

THE GROWTH OF THE CO-OPERATIVE MOVEMENT IN DENMARK.

(From the *Journal of the Board of Agriculture*, Vol. XVIII., No. 6, September, 1911.)

The Board have received through the Foreign Office the following report, which has been drawn up by Mr. R. Turner, late Vice-Consul and Archivist at H. M. Legation at Copenhagen, on the growth and progress of the co-operative movement in Denmark.

Growth of the Co-operative Movement.—Until the latter half of the last century Denmark was a corn-producing country, but from thirty to forty years ago various causes combined to ruin this branch of agriculture in the country, and it was then that Danish farmers began to take up dairy farming. Such success attended this departure that Denmark is now cited as being second in the list of European countries ranked according to wealth per head of the population. The new departure was from the beginning encouraged by the Government, and the judiciously applied State aid is in no small measure responsible for its success.

Apart from the geographical and other natural advantages which Denmark enjoys as regards this special branch of the agricultural industry, its success is to be very largely ascribed to the perfection to which the system of co-operation has been brought in the country. In 1890, when the co-operative movement was as yet in its infancy, the butter exported from the country (to take one instance) was calculated at 97,480,000 lb., while in 1905 Denmark exported 186,360,000 lb. of butter. At the same time the number of co-operative dairies had increased from 781 to 1,068 (exclusive of some 200 communal dairies).

Danish Co-operative System.—The system of co-operation as practised in Denmark may be said to be an adaptation of the English Rochdale system. The first step was the foundation of a co-operative supply stores about the middle of last century, and this was followed in 1882 by the first co-operative dairy, which was started in that year by Herr Stilling Anderson at Hjedding. The movement has now developed so far that there is not a single matter of interest to the farmer that has not become the object of co-operation. The motto of co-operation in Denmark may be said to be "Each for all and all for each." This applies both to the liability incurred in raising the loan necessary to commence the undertaking, whatever it may be, and to the division of the profits of that undertaking.

Co-operation and Small Holdings.—Before dealing with the individual branches of agricultural co-operation in Denmark, it is necessary to give a brief glance at the conditions under which they have come into existence and flourished. A very well-informed Dane, in discussing the subject, stated that, in his opinion, the success of the co-operative movement in Denmark was dependent on the small holdings system, and, conversely, that without co-operation the system of small holdings would be impossible.

Land Legislation in Denmark.—The tenure of land in Denmark is, as regards the larger states, very similar to that in England, and no special notice need be paid to it as concerning the object of this report. As regards small holdings and peasant farmers, however, the position is different. All land legislation in Denmark for the past hundred years has tended to the formation of a peasant class *owning small farms*, as against the formation of large estates. Thus, an estate owner is encouraged to sell small holdings or farms to the peasants. Once a farm is in existence it must either be kept intact with all its buildings upon it, or it may be divided into two or more farms each to be worked separately, *but it may not be incorporated into another to form one large farm.* Then, too, the State has established a fund to advance money under very easy terms to suitable peasants to enable them to purchase holdings for themselves. The peasant must have saved a certain sum of money (in some cases about 10 per cent. of the purchase money of the holding—which varies between £170 and £300, including stock—is considered sufficient), and the State advances the rest at 3 per cent. interest, and with great facilities in the matter of repayment, retaining a mortgage on the land. Thanks to beneficial legislation, a great portion of the agricultural population in Denmark own the land they work. There are about 2,117 large estates, 75,320 peasant farms of from 20 to 150 acres, and 68,000 small holdings varying from 3 to 7 acres.

Prosperity of Peasant Farmers and Small Holders.—The peasant farmers and small holders are very prosperous; the latter are paying off the mortgages on their holdings, and it is found that the previous movement of the rural population to the towns has been in a large measure arrested. In this connection it may, too, be mentioned that since the State has offered pecuniary

assistance to agricultural labourers to acquire their holdings, there has been falling off in the number of emigrants.

Advantages of Co-operation to Small Agriculturists.—The peasant farmers and small holders, being naturally men of small means, would in many instances have found it very difficult to bring their produce to an advantageous market. By means of co-operation the small man is able to reach the best market possible. The co-operative dairy, of which he is a member, buys his milk of him at the market rate, and sells him back at a low price the separated milk on which he feeds his pig. The pig he sells to the co-operative bacon factory at a price determined by the demand of the British market, while his eggs are disposed of to the co-operative egg export association. In this manner he receives as good a price as if he were able to bring his produce himself to Copenhagen, nor do his benefits from co-operation cease there. He obtains all he wants for himself, his family, or his farm from a co-operative supply association, while a similar association insures him.

Character of the Danish Peasant.—It must not be forgotten that the Danish peasant is a very hard-working man. His hours are generally longer than in England, and his way of life cheaper. He is also very honest. This honesty, and the mutual trust which results from it, may be taken to be the moral foundation of the co-operative movement in Denmark. Without this mutual trust, which is doubtless strengthened very greatly by the fact that, distances being small, most members of a co-operative undertaking are personally known to each other, it is difficult to imagine how the co-operative movement could have grown so rapidly.

Education.—To this innate honesty one must add an excellent education, received in the first instance at the State school, and later at one of the high schools, agricultural colleges, or cottars' schools. These schools, by bringing young men and women of the agricultural classes together, are undoubtedly not without their value in preparing them for working along co-operative lines.

These observations may, perhaps, be considered beside the mark, but the extraordinary success which has attended the introduction of co-operation into Danish Agricultural life, cannot be ascribed solely to geographical formation and favourable legislation.

Co-operative Dairies.—The first co-operative dairy in Denmark was founded in 1882 in Jutland, and the movement almost immediately became general. So quickly, indeed, did co-operative dairies spring up over the whole country that in 1903, which unless otherwise stated, will be the year of all figures given in this report, there were some eleven hundred such dairies.

Extent of the Movement.—A better idea of the extent of the movement will be gathered from the fact that there are 174,742 farms with cows in Denmark; of these 143,863, or 82·3 per cent., are in the hands of men who are members of a co-operative dairy. *N.B.*—As these figures date from 1903, it may safely be taken that there has been some increase since that year, and it may be added that when the statistics were taken, some 4,800 of the circulars sent out were returned either not filled up, or unsatisfactorily filled up, so that these figures represent a minimum not a maximum. Again, of the 1,066,698 cows in Denmark, 862,986, or 80·9 per cent. are owned by farmers who are members of co-operative dairies, while of the remainder about 10 per cent. deliver their milk to joint dairies, so that about nine-tenths of the milk produced in the country is dealt with in dairies working on the principle of association.

Participation of Different Classes in the Movement.—At this point it is of interest to note the manner in which the different classes of farms participate in this movement. Of the very small farms only 3·1 per cent. are members of a co-operative dairy, but at the same time the milk of 58 per cent. of all the cows owned by this class of peasant farmer is delivered to some such dairy. In other words, most of these farmers are too small to possess a cow, while more than half of those that do are members of a co-operative dairy,

The next class most weakly interested in the co-operative dairy movement is that of the large farmers—in many cases the great land-owners—of whom only 43·3 per cent. are members of a co-operative dairy. In this case the reason is to be found in the fact that they are very often owners of dairies in which they deal with their own milk—in some few cases even adding to it by buying milk from their smaller neighbours.

Between these two extremes about 85 per cent. of all the farmers are members of a co-operative dairy, *i.e.*, about 85 per cent. of the milk produced in the country is sold to a co-operative institution.

Benefit of Co-operative Dairies to Smaller Farmers.—The immense benefit of this movement to the smaller farmers can hardly be over-estimated. It was formerly practically impossible for the smaller man to deal with the milk produced on his farm in such a manner as to secure a high and uniform standard of butter and cheese. He had to rely on the local market for the sale of his produce, and there was besides a considerable wastage of by-products. Under the co-operative system—which owes its success largely to the introduction of the centrifugal separators, which render it possible to deal with larger quantities of milk expeditiously—the smaller farmer is assured of the best market obtainable, has more time for properly attending to his farm and stock, is able to buy back at a very low figure by-products such as separated milk, which he may need for his own purposes, and, most important of all, he has won the reliance of the market on the high and uniform standard of his produce.

Management of a Co-operative Creamery.—The Society having been formed, an executive committee is selected, it in turn electing its chairman, vice-chairman, and treasurer. The elections hold for a year. The committee appoints a manager, who is generally paid a lump sum yearly, out of which he has to pay the employees and himself. This system has many obvious disadvantages, and it is not unlikely that it will in time be changed. The manager, besides engaging the employees and supervising the working of the dairy, has to keep the books and generally control the whole business of the undertaking.

Fittings of the Creamery.—The creamery is almost invariably supplied with steam-driven centrifugal machines, and has one or more separators and pasteurisers, according to the amount of milk dealt with. The machines generally drive an electric plant and a cooling apparatus. All utensils are very carefully cleaned, as are the milk cans before their return to the farmer. Most of the machines and utensils appear to be of Danish manufacture, but English and German marks are sometimes seen. Great attention is paid to cleanliness in every department, and the farmers also are required to observe a very high standard in this respect.

Cartage of Milk.—The cartage of milk is generally done by the dairy society, who, in most cases, let it out to a contractor. The dairy charges the farmer so much per hundred pounds of milk. These charges vary from three to ten ore (rather less than ½d. to about 1½d.). The farmers are bound to deliver the milk on the main road, where it is collected by the carrier. It is common sight in Denmark to see two or three milk cans standing by the side of the road for the carrier to pick up. These cans hold a hundred pounds of milk and are supplied by the dairy.

Treatment of the Milk.—The milk is weighed on receipt at the creamery and entered to the subscriber's account. Payment is made according to the amount of butter-fat contained in the milk. Every dairy makes regular tests of the milk supplied by its subscribers, and any falling below a certain standard is immediately notified to him, and if the fault is not remedied his milk is refused. Great care is also exercised to prevent milk from any diseased animals being sent to the creamery. Some co-operative societies even go the length of undertaking partially to indemnify a subscriber who suspects one or more of his cows of being tuberculous, and, in consequence, does not send his milk to the creamery.

Formation of a Co-operative Dairy.—The capital required to start an average Danish creamery varies from £1,200 to £1,500. This sum, which would cover everything, is advanced to the Co-operative Society by a bank or other institution having money to invest. The farmers forming the society pledge themselves, each according to the number of cows on his farm, to be liable for this loan. The bank holds a mortgage on the factory or creamery, and has further right of recovery against each farmer in proportion to the extent of his guarantee. The farmer undertakes to sell *all* the milk produced on his farm for a certain number of years—the period varies in the different societies from seven to twenty years—to the co-operative dairy, and to observe a certain number of rules as to feeding of cows, treatment of milk, utensils, and so on. Infringements of these rules are punishable by fine, but such cases are of very rare occurrence. Each member signs an agreement drawn up in the above sense, binding himself and his farm to the observance of the rules therein contained. It thus follows that if a farm changes hands during the period for which the farmer has become a guarantor, the liability rests on the new owner.

Number of Creameries in Denmark in 1908.—The figures for the year 1908 show that there were in all 1,345 creameries in Denmark at the beginning of the year. Of this number thirty-three belonged to

private persons (Heeresgaardsme jerier), 211 were communal dairies (Faellesme jerier), and the remainder, 1,101, were co-operative dairies.

Associations of Co-operative Dairies.—The greater number of these dairies are again associated in various ways. The most comprehensive of these associations is, perhaps, the Committee of the Federated Danish Dairy Associations (De samvirkende Danske Mejeriforenings Forretningsudvalg). This Committee, which was founded in 1899, consists of the Presidents of the Associated Dairies' Unions of Jutland, of Zealand-Lolland-Falster, and of the Funen Dairies' Association, in other words, of the dairy association of the whole of Denmark proper. Its object is to consider the proposals to be laid before the yearly meetings of the association, and to endeavour to concentrate and unite the efforts of the various societies in all matters connected with dairy associations. The State, in the yearly budget for 1907-8, granted the Committee Kr. 4,000 (£222) towards the expenses of butter exhibitions, and Kr. 1,000 (£55) for the wages of a consultant in the control of the dairies.

Taking next the local associations of dairies, the Presidents of which form the Committee above-mentioned, we find the Associated Dairies' Union of Jutland, composed of all the thirteen minor dairy associations of the peninsula, who again have as members 504 dairies. The object of this association is to form a connecting link between the various dairy associations of Jutland, and in general to further the interest of the dairy industry by holding butter competitions, exhibitions, giving advice, and so on. Each dairy association pays a yearly contribution calculated upon the amount of milk dealt with (in the year 1907-8 this contribution was Kr. 3 (3*s.* 4*d.*) per million pounds of milk), and each association sends one representative for each seven dairies of the association. The union has a yearly budget of Kr. 14,000 (£777). The subscriptions amount to Kr. 6,000 (£333). The State contributed Kr. 6,650 (£369), which was expended in securing the services of an expert as consultant, in arranging butter exhibitions, and generally in forwarding the production of milk and butter.

The Associated Dairies Union of Zealand and Lolland-Flaster has a membership of five dairy associations, or in all 140 dairies. The Dairy Association of Funen is composed of 145 dairies. Both these associations have generally the same object as the Jutland union above-mentioned.

Election of the Boards of Co-operative Institutions.—As a general rule all associations in Denmark coming within the scope of co-operation are controlled by a committee and chairman elected for different lengths of time—usually for a year. It has been found that it is better to keep such committees separate, and as a consequence we find a number of such boards—in the smaller districts and villages often composed of the same men—directing different undertakings in the various branches of agricultural co-operation, and work side by side throughout the land.

The contributions to the dairy associations are generally based on the amount of milk dealt with; in the case of the dairies themselves sometimes on the number of cows belonging to the subscriber, sometimes on the amount of milk; while in the case of bacon factories the subscription is, as a rule, regulated by the number of hogs slaughtered, the subscriber in this latter case generally guaranteeing a fixed sum.

Larger product of the Cows on Smaller Farms.—The average yield of milk from cows on farms of the two smallest classes is considerably higher than that on larger farms. This is probably largely due to the fact that on the smaller farms the number of cows kept is proportionately fewer, and the farmer is consequently able to attend to them personally and more thoroughly than is possible on a larger scale.

Control Societies.—In 1895 a new departure was made in agricultural associations, by the formation of the first Control Society (Kontrolforening); the number had increased to 479 in 1907, with an aggregate membership of about 12,000. These societies are aided by the State, the subvention in 1906-7 being Kr. 120,000 (£6,666).

Formation of Control Societies.—Though not actually co-operative undertakings, these societies are formed on co-operative lines by the farmers in various districts. A membership of eight is necessary before the society can receive State aid, though this aid may be refused by the Minister of Agriculture in certain circumstances.

Object of Control Societies—Improvement of Breed of Cattte.—The principal aim of these societies is to improve the milk-producing capacities of the breed of cattle in Denmark. With this object an expert is appointed as controller (it is calculated that one controller can look after about 1,000 cows). This officer travels from one farm to another in his district and gives the farmers advice as

to the cows they should select for breeding purposes, and the bulls to which it would be best to put them. The farmer has to keep a record of the weight of milk yielded by each cow, and of the butter-fat contained therein, together with details as to the amount and nature of the fodder supplied to the cow. By this means the controller is able to advise as to the profitableness of the animal. The practice of breeding only from such cows as are good milkers is said to be tending towards the production of a breed possessing unusually developed capacities in this direction.

Other Functions of the Controller.—Beside the main object of improving the breed of cattle, the controller also gives advice on other branches of agricultural industry, such as the pigs, roots, &c. He also keeps duplicate account books for each farm, being both auditor and adviser to the farmer.

Co-operative Bacon-curing Factories.—Second only in importance to the dairying industry in Danish agricultural life is the bacon-curing industry. In 1887 the import of Danish pigs in living state into Germany was prohibited, and the Danish farmer was himself obliged to look for another market. One or two old-established firms in Copenhagen had for some years been dealing with British market in salted bacon, and hence the first inclination was towards Great Britain. These firms were private concerns, and used the opportune excess of supply over demand to reduce the price given to the Danish farmers for their pigs, while maintaining to a very large extent the price to their customers in London. This state of things was eminently unsatisfactory to the farmer, who having the success of the recently started co-operative dairies before his eyes, decided to experiment in co-operation in this branch of agriculture also, and the first co-operative pig-killing and bacon-curing factory in Denmark was founded at Horsens in 1888. A certain amount of difficulty was experienced at first, the established private firms naturally offering such position, and the experience gained in co-operative dairying being only to a slight degree applicable to this new departure.

Growth of the Movement.—Despite various obstacles, the success of the movement was assured from the beginning. Eight new co-operative factories were established in the second year of the movement, and the number has grown yearly since. The number of co-operative pig-killing and bacon-curing factories in 1908 was thirty-six, with a membership of about 95,000. (Besides these co-operative factories there were twenty-four private firms, so that the total number of enterprises in this branch of the industry was sixty.)

Constitution and Organisation of Co-operative Pig-killing and Bacon-curing Factories.—The constitution of a co-operative pig-killing and bacon-curing factory is, *mutatis mutandis*, materially the same as that of a co-operaative dairy. The area over which the members of a co-operative slaughtery are scattered is naturally larger than that covered by a dairy. The consignments to the factory are neither daily nor in small quantities, as in the case of dairies, but at longer intervals and in larger quantities. Again, the perishable nature of milk necessarily limits the distance over which it can be transported, while with the live pig this is not the case. The risk of transport are borne by the factory once the pig has been consigned; moreover, the factory bears the cost of transport for such pigs as are sent by train, so that all pigs, whether from far or near, arrive at the factory at an equal minimum of cost to the farmer.

The money for erecting the factories was raised by loans, as in the case of the dairies, the guarantee being in this case also for a certain number of years, generally five, seven, or ten. In most cases the original loans have already been paid off, and the factories are owned by the members themselves. The members bind themselves to deliver all their pigs to the factory (generally with the exception of the sows and hogs for breeding purposes and young pigs under a certain weight). They may, however, sell to a fellow-member, upon whom the obligation towards the factory devolves. Special rules are made as to the admittance of new members subsequent to the foundation of the factory.

The members elect their committee, which in turn elects its chairman and vice-chairman, and appoints a director of the factory, and in some cases certain other officials. The Director manages the factory under the control of the committee.

The Associated Danish Co-operative Pig Slaughteries.—This association (De Samvirkende Danske Andels-Svine-slagterrier) was founded in 1897, and thirty-three out of thirty-six co-operative slaughteries in Denmark belong to it. It consists of members of the committees of all the associated factories, who elect a committee of five of their members, who stay in office for two years; and of

two factory directors who hold office for a year. The expenses of the association are divided among the associated factories in proportion to the number of pigs they have slaughtered, and varies from one to two öre per pig—in all about Kr. 15,000 (£833).

The objects of this association are to represent the interests of the industry as regards legislation, to secure the best information as to transport of and demand for slaughter-house products, to work for the improvement of Danish bacon by affording the assistance of scientific consultants, &c., and to promote rational pig breeding. (There are other associations for the improvement of the various breeds of pigs, some of which are assisted by the Government, but which are not co-operative in their constitution.)

A very important function of this association is: "To diffuse immediately the latest intelligence regarding the bacon industry among those concerned." The endeavour to introduce a common quotation of prices for bacon produced in Denmark has only met with partial success up to the present. The abattoirs of Jutland and Funen have established a board which, on the receipt of bi-weekly dispatches from England, fixes the price as far as these abattoirs themselves are concerned. The Zealand and Lolland-Falster markets are, however, somewhat influenced by the neighbourhood of Copenhagen, and it has hitherto been found impossible to establish a general quotation for the whole country. The association, however, keeps its members informed of the state of the market and of the number of the pigs slaughtered in Denmark and Ireland, so that a very good idea of the prices can be formed by the factory directors.

The action of the association in having a scientific veterinary expert at the disposal of its members (the Government have made a grant of Kr. 2,000 (£111) yearly towards the expenses of this expert) has contributed largely to the success of the Danish bacon industry. The Agricultural High School has also placed its laboratory at the disposal of the association for purposes of experiment.

It is also due to the association that the veterinary control of exported meat, which was regulated by the Law of July 29th, 1903, was recently revised, and that the standard was so raised that foreign customers of Denmark can be certain that they receive nothing but absolutely sound meat.

THE WORK OF THE ECONOMIC ASSOCIATION.

(From the *Manila Bulletin.*)

We have read with great interest the proposal of the Association to encourage the establishment of banks throughout the archipelago as well as the announcement that in several cities and municipalities evidences that hearty co-operation on the part of the leading Filipino citizens has been engaged.

As is well set forth by the Association the urgent need of the country is the active circulation of money which for one reason and another has been withdrawn and hoarded. The postal savings bank has served to encourage the people who heretofore hoarded their wealth to utilize the bank, and there is reason to believe that lack of confidence in banking institutions throughout the provinces has been more or less overcome, and the way prepared for the very necessary local institution as an avenue for safe deposit and local investment. All the money available in a municipality is now in large measure hoarded, serving no purpose and could be utilized through the bank to aid in the greater development of agriculture and industry, and the investment thus made would be right at home where the community generally would benefit.

Such institutions would inspire confidence and educate the growing generation in a broader conception of local economics. Instead of the scarcity of money and usurious rates of interest money would be plentiful and at reasonable rates.

The Philippine Legislature is to be asked to meet the people half way to subscribe an equal amount out of the insular treasury to that provided by the Filipino subscribers. We believe this to be a very reasonable proposal. Insular funds could not be utilized to better advantage. It would be one step and an important one in the direction of economic emancipation.

We have been advocating for years that the greater influence and activity of the government should be directed in encouraging the Filipino to economic independence. It is true that little or no inclination to advance along material lines were demonstrated, so that there was very little the government could do. But the proposal of the Economic Association is what we have been looking for. The Filipino as an individual comes forward with a desirable proposition. He offers to put up a pledge of so much to back his faith in the Island's indus-

trial future if the Government will cover it. This seems to us to be the very spirit we have been hopefully anticipating. If the legislature fails to respond and go partners in this economic adventure, then that body will be guilty of the admission that the majority of its members have less faith in the country's industrial future than the individual Filipino who is willing to put his money in it.

EDUCATION FOR THE COUNTRY LIFE.

(From *Nature*, No, 2,194, Vol. 88, November 16, 1911.)

The Teaching of Agriculture in the High School.—By Garland A. Bricker, pp. XXV+202. (New York: The Macmillan Co., London: Macmillan & Co., Ltd., 1911.) Price 4*s.* 6*d.* net.

Students of rural affairs have long realised that much dissatisfaction exists in country districts with our present system of education. In whatever way it is judged, according to its critics, it has failed; the children sent out from the country schools are not better fitted for work on the land than their fathers were; on the contrary, they are kept at desk work during the period when it is supposed that their respective faculties are at the best, and when they would; on the land, most rapidly learn the ways of animals, of plants, and of soils. Even the friends of the system will concede that it has been evolved without any special regard for country requirements, and without taking account of the fundamental differences in habits of thought and in points of view between the dwellers in the town and those in the country.

More and more it is being realised that the future development of the rural district, or to put it still more widely, of the country civilisation, must run on different lines from that of the city, and experiments are therefore being made to evolve a system of education that shall train children to lead the life of the country. The experimental scale is largest in the States, as one might expect, and in the book before us Mr. Bricker has collected such of the material as is at present available, thus usefully filling a gap in our education literature. It is, of course, as yet too soon to speak about results, but during the experimental period it is useful for educationists to know what their American *confrères* are doing.

Of the elementry school but little is said. The nature study idea is for the present the best we have, and has already a copious literature of its own. The work of the elementary school, according to the author, should confine itself to an elementary study of the common things of the farm, field, and forest. Something of the relative importance of these things to man should be studied and fixed in the mind of the child before he leaves school. It is in the secondary school, or, as it is here called, the high school, that the scholars will take up agriculture as such, but there is no break in the sequence of studies because agriculture will be looked upon as nature-study *plus* utility. But the study of agriculture is to be an education and not simply a manual training.

"If the essence of true culture is to see the fundamental and eternal shining out through the seemingly trivial and transitory, there is no subject better adapted to provide culture than the subject of agriculture."

To be treated in this broad way, agriculture requires a larger place in the school curriculum than the established secondary schools are able or willing to give it; hence the necessity for separate agricultural schools. Two possible dangers are indicated; specialised schools may emphasise class distinctions unworthy of a democratic country; education that makes a strong appeal to economic motives may be harmful if it places its powerful sanction on self-seeking ideals. The purely practical man, of course, will ask: Of what use are culture and adornment if the power to earn a livelihood is lacking? But this must not be the point of view of the agricultural teacher. He must rather insist on the other question: Of what use is the best capacity to make a living without a corresponding power to make life worth while? and make agriculture a cultural as well as a vocational subject. In short, the agricultural secondary school is to be the directive and constructive agent of the new rural civilisation that the best men in the States (and, for that matter, in this country also) are endeavouring to foster.

A chapter is devoted to the description of schools already established. They are, as one would expect. of several types, but in all of them boys and girls are educated together, entering at the age of thirteen or fourteen, and remaining for three or four years. Agriculture for the boys and household science for the girls form the respective centres of the courses, and the education is made as real as possible, *i.e.*, the thing itself, whether a horse, a maize seed, or a growing crop is before the class, and not simply a picture.

The author then proceeds to a discussion of methods. The logical arrangement of subject followed in a college course is not the best for the boy with his limited experience and his incomplete and unorganized knowledge. It is necessary to adopt a psychological arrangement, *i.e.*, a sequence of studies adapted to the changing and the developing powers of the scholar. That the subject generally accords with instincts, and the impulses of the average boy is a tremendous help, and yet, unintelligently directed by the teacher, this help may prove a great danger. Into the psychological discussions we need not enter. The author's aim is to show that pedagogic principles can and should be applied to the teaching of agriculture, and that the subject can and should be made cultural as well as vocational.

The book affords a striking illustration of how much further the Americans have got then we ourselves. We are only commencing—if indeed we have seriously commenced—to apply the science of education in our agricultural teaching. Those who propose to essay the task will obtain useful help from this book.

MISCELLANEOUS.

PERADENIYA EXPERIMENT STATION.

Minutes of a meeting of the Committee of Agricultural Experiments held at the Experiment Station, Peradeniya, on 9th November, 1911.

Present:—The Director, R. B. Gardens (Chairman), the Assistant Director, the Government Entomologist, the Government Mycologist, the Government Chemist, Mr. W. N. Tisdall, and the Secretary.

The Progress Report since the previous meeting was read.

Resolved :—

1. That the tapping of *Manihot dichotoma* be discontinued.
2. That the name of the paddy that is to be planted out be ascertained, that it be planted 10″ × 10″, and that the manuring be continued with the exception of the plots being experimented on by Dr. Lock.
3. That Government be approached *re* the sale of the cattle now on the Station, with a view to acquiring a better class of stock.

J. A. HOLMES,

Secretary C. A. E., and
Superintendent, E. S. P.

PROGRESS REPORT ON EXPERIMENT STATION

FROM 7TH SEPTEMBER TO 9TH OCTOBER, 1911.

TEA.—The tea has been flushing well, and the results of systematic green manuring are very appreciable in the plot thus treated.

Supplies are being put in according as they are obtained, but it is somewhat difficult to get them from the original sources.

CACAO.—Two sprayings have been effected since the last meeting and a fair crop is now being gathered.

RUBBER.—*Para.* Plot 78 was manured as previously.

Plot 87 has been forked.

Appended are the monthly averages for the various acres. Ceara and Manihot rubbers are yielding very poorly.

COCONUTS.—Plot No. 8 was ploughed, making two ploughings for the year.

Plot No. 9 had its bi-mensual application of soluble mixture.

Plot No. 13. Cattle were tied at night to the trees for the third time.

PADDY.—The paddy field is just about to be planted with nursery grown seedlings.

COFFEE.—A variety of coffee obtained by Mr. Bamber in Java known as Uganda Coffee has just been planted out.

GREEN MANURES.—*Leucæna glauca.*

When pruned.		Weight of organic matter.
25, 1, 1911	...	176
4, 4, 1911	...	136
31, 5, 1911	...	132
9, 8, 1911	...	164
13, 10, 1911	...	165
Total	...	773 lbs.

GENERAL.—A portion of the newly-cleared land is already sown in Maize, Castor and Sweet Potatoes. Various varieties of local products are on order to plant up the remaining acres.

Cassava of two varieties planted in April, 1911, has just been harvested.

Cost of crop, ¼ acre	Rs 17·38	
Green cassava weight for ⅛ acre ..		1,613 lbs.
Red		2,696 ,,
	Total	4,309 ,,
Profit from selling at one cent per lb. ..	Rs. 25·71	

RUBBER—PARA.

MONTHLY AVERAGES FOR THE VARIOUS ACRES.

Plot 79.

	Average in grammes.	Average in ounces.
April ..	34·29	1·21
May ...	23·86	·84
June ...	10·97	·38
July ...	39·21	1·38
August ...	31·75	1·12
September ...	91·9	3·26
	231·98	8·19

Plot 82 A.

Average for 12 months, viz., August, 1910, to July, 1911 ...	586·14	20·78

Plot 82 B.

Average for 12 months,	588·94	20·88

Plot 82 C.

June ...	29·02	1·02
July ...	61·5	2·18
August ...	50·00	1·77
September ...	61·62	2·18

Plot 80 A. & B.

Using the Bamber pricker only resulted in a very large percentage of scrap in the proportion 3 to 1, owing to small excresences on the bark.

Young Cocoa—proposed manuring Experiments.

Manures.—Apply 1912 and leave untouched 1913 and 1914.

9 half-acre plots, ¼ acre surface manured.

1. Ten tons cattle manure as mulch.
2. Ten tons cattle manure forked in.
3. 200 lbs. basic slag buried in trench with leaves.
4. 200 lbs. basic slag broadcast and lightly disc harrowed (scratched in).
5. 200 lbs. ammonium sulphate broadcast and disc harrowed.
6. 200 lbs. basic slag and 100 lbs. potassium sulphate broadcast and disc harrowed.
7. 200 lbs. basic slag, 100 lbs. Potassium sulphate and 400 lbs. Castor cake.
8. 3 cwt. of bone dust.
9. Unmanured.

Each plot consists of two rows of trees *between* which the various manures are to be applied.

ITINERARY IN VIYALUVA (UVA PROVINCE).

(Report by the Agricultural Instructor of the Central Circuits.)

I have the honour to report that I have, with the kind assistance of Mr. Bibile Ratemahatmaya, carried out a useful programme of work in Viyaluva.

2. I started work in Viyaluva with a ploughing demonstration at Timbirigaspitiya got up by the Ratemahatmaya, who was present with his headmen and paddy cultivators at the demonstration. The plough used was the Empire—lately introduced by Messrs. Hunter & Co. Those who witnessed the demonstration agreed with the Ratemahatmaya that the plough worked well. The Ratemahatmaya has ordered more ploughs and is lending them out to villagers.

3. I held meetings or conferences at Soranatota, Tennepanguva, and Beramada, and went fully into the subject of Agricultural Improvement. At present the only cultivations carried on by the villagers are paddy and chena, and these on the primitive methods, without any consideration of improved and modern methods. This Ratemahatmaya, who takes the greatest interest in all matters of agriculture and the general improvement of the division, has not only adopted improved methods of paddy cultivation, but has initiated rotation of crops in chena lands. It is now for the villagers to take them up. They have the opportunity to see for themselves the good results of such experiments. Mr. Bibile is carrying on a four-crop rotation in a chena close to his residence.

4. There has been a great tendency in Viyaluva to sow more seeds than actually necessary for a paddy field, and no transplanting is carried on. Mr. Bibile has this year set an example by sowing as much seed as is necessary, and I understand that the cultivators who had anticipated failure, are now beginning to realize that hitherto there has been a great wastage of seed paddy. There has also been a practice to cultivate paddy lands out of season, but the present irrigation rules do not permit this. I have taken every opportunity to speak to the people on the possibilities of improving paddy cultivation, and I think that, with the example set by the Ratemahatmaya, there is good prospect of improvement.

5. The methods of chena cultivation in Viyaluva is not satisfactory. Kurakkan is the only dry grain largely cultivated. Very little of other grains or

pulses are grown. Certain parts of this division are suitable for cotton cultivation and tobacco. I gave full instructions to those who undertook to cultivate cotton and tobacco.

6. There is no garden cultivation in Viyaluva to speak of. Most kinds of native vegetables, and in some localities also foreign vegetables, can be successfully grown. At Tennepanguva School, at the time of my visit, vegetables were thriving well. In the near future sufficient land is to be given to Soranatota and Beramada schools. With these school gardens as models, to show the villagers how to cultivate marketable products, and with the assistance of Agricultural Instructors, I think the district should be able to produce sufficient vegetables for local consumption.

7. There are no permanent cultivations carried on by the natives. Coconut and arecanut do well in some parts. There are Tea and Rubber estates belonging to European Companies. At Beramada there is a rubber estate of over 1,000 acres.

8. The chief hindrances to progress are the laziness and conservatism of the people. It is well known that, if the villager has sufficient to eat, he is not inclined to stir. And the villagers of Viyaluva are no exceptions. They are conservative to a degree and sceptical in the face of convincing proof that new methods are an improvement on their own.

9. *Water Supply.*—The present state of the irrigation channels is satisfactory, and the irrigation rules do not permit of any wastage of water. The water supply is limited and the rainfall low.

10. There is only one school garden, viz., Tennepanguwa. When land is acquired for other school gardens, and a fair water supply made available on the premises, there should be good work done. The garden at Tennepanguwa is in a sorry state just now, as the drought has killed all vegetation.

11. I have every reason to hope that the agricultural condition of Viyaluva will continue to improve with the help of Bibile Ratemahatmaya, who greatly facilitated my work in that district. His headmen met me with the villagers whenever I had aranged to hold conferences and give demonstrations.

WALTER MOLEGODE,
Agricultural Instructor.

NEW FOREST LEGISLATION IN ITALY.

In the last two numbers (July and August) of the *Bulletin of Social and Economic Institutions*, published by the International Institute of Agriculture, there is a special study on the above subject, from which we derive the following details :—

Previous to June, 1910, when the law on the State Forest Lands was promulgated, Italian Forestry questions were regulated by the law of 20th June, 1877, and some others of less importance. The law of 1877, with a view to ensuring the stability of the soil, a good water system, and, secondarily, good local sanitary conditions, forbade all deforesting and clearing of forest soil, subjecting to the *vincolo forestale* (forestry régime) the woods and lands denuded of trees on the summits and slopes of mountains, down to the higher limit of the chestnut zone, as well as those that by their character and position, might, if deforested or cleared, become a public danger.

The law further instituted, in every province, a forestry committee, presided over by the Prefect, to settle the rules for forest cultivation, wood cutting and other delicate matters. But, in spite of these provisions, there was reason to lament an excessive and ill-regulated deforesting, giving rise to landslips, devastating torrents and floods, often producing serious crises in the economy of the mountain regions.

The necessity for special remedial measures was then apparent. Some of these were provided in the law of 2nd June, 1910, "*On the State Forest Domain and the Protection and Encouragement of the Forestry*"; others are contained in two bills (30th November, 1910); the first on *Modifications of the Forestry Law of 1877 and Provisions for Mountain Pastures and Agriculture*, the second on "*Forestry Training.*"

The main article of the law of 2nd June, 1910, is the formation of a State Forest Administration as an independent institute, "to provide for the extension of forest cultivation and the trade in national forestry produce by increasing the State forest property and rendering it inalienable and by the example of a good industrial régime."

The domain is formed: (*a*) of State forests already declared inalienable; (*b*) of State forests at present administered by the Finance Department; (*c*) of State lands held to be economically only

suited for forest cultivation; (*d*) of wooded lands purchased by the Forest Domain Institute or in any way becoming the property of the same; (*e*) of treeless lands purchased or expropriated by the same; (*f*) land reafforested or to be reafforested, by vritue of special laws by the Department of Public Works, and that the Agricultural Department shall think fit to incorporate in the Domain.

Woods and lands that thus come to form part of it are inalienable, and must be cultivated and utilised according to a regular economic plan, approved by the Minister of Agriculture, Industry and Commerce.

Art. 17 of the law is especially interesting. It authorizes the forestry administration to receive advances and lcans from the Land Credit or Agricultural Credit Institutes and the Savings Banks.

For the protection of forest cultivation, it is provided that the woods belonging to the Communes, the Provinces, public institutions, corporations, associations and limited liability societies must be utilised as prescribed by the forestry authority.

For reafforestation of severally damaged woods, the Department is authorized to direct gratuitously the technical labour and to give prizes of from 50 to 100 francs per hectare.

Lands, bare or covered with bush or grass, when they are scientifically reafforested by their owners or by consortiums of owners are exempted from the land tax for 15 years if cultivated as copsewood, for 40 years if cultivated for the production of full grown trees.

The central or local forestry authority further gives gratuitous assistance to the forest cultivators for the defence of small mountain properties and encourages the foundation of associations and consortiums of forest proprietors.

The sum of 33 million francs has been assigned for the carrying out of the *law during the first five years;* at the end of which period the amounts necessary each year will be inscribed on the Agricultural Estimates.

To complete this fundamental law, the two bills above mentioned were presented to the Chamber. By *the first*, provision is made for a more scientific system of preserving the woods and grazing lands and for the increase of forest industries. The *vincolo forestale* is modified in accordance with the dictates of science and practical experience, and the provincial forest committee reorganized wth the participation of persons technically and legally qualified. The criterium of the chestnut zone, hitherto taken as the limit of the lands of the forestry régime, is consequently abolished. Other provisions deal with the penalities and the conciliation institute for contraventions of the forestry regulations.

Finally, a very important and novel portion of the bill relates to *mountain pastures.* It establishes subsidies for the creation, improvement and regulated use of the grazing grounds and mountain meadows and for the works connected with the regulation of the water supply. The period damaged grazing grounds must lie fallow is also regulated; this naturally causes a break in the owner's use of them, but he receives adequate compensation during the period the State is arranging for the restoration of severely damaged grazing grounds.

The second bill has reference to "*foreslry training*": in it the foundation of a "Higher National Forestry Institute" is proposed, the principal object of which is to provide for the superior technical instruction of the forestry officers required for the service of the special State Forest Domain Institute and for the application of general and special forestry laws. It is also proposed to institute a "Royal Forestry Experimental Station," to assist in the progress of forest cultivation by means of scientific and technical research. Finally, provision is made for secondary forestry training, itinerant teaching and for the training of the forestry guards.

(Summarised from the *Bulletin of Economic and Social Intelligence*, Year 11, N. 7 & 8, July 31st and August 31st, published by the International Institute of Agriculture.)

REPORT ON THE DANISH SYSTEM OF TAXATION.

BY MR. VICE-CONSUL FUNCH.

(From the *Diplomatic and Consular Reports*, April, 1907.)

(*Continued.*)

Reform of the System of Taxation.—The motives for the reform of taxation in Denmark may be summarised as follows:—

(1.) The growth of the local burdens year by year.

(2.) The injustice of using the old valuation as a basis for local taxation,

(3.) The inequality arising from the fact that non-agricultural land and buildings did not contribute towards the local taxation.

(4.) The prevailing dissatisfaction as to the payment of tithes.

Finally, Parliament determined to create an entirely new system in lieu of endeavouring to effect improvements in the old. In place of the old land taxes and the building tax, based on a permanent valuation, a real property tax, based on periodically recurring valuations, was established, with, at the same time, an income and property (capital) tax to the State. All the old State taxes (except the title tax) were abolished.

THE TAXES ABOLISHED IN 1903.

	Value in 1,000,000 Kr.	Value in 1,000*l.*
Copenhagen ...	2·1	120
Other towns...	1·7	90
Rural districts	7·2	400
Total ...	11	610

THE NEW TAXES AFTER THE ASSESSMENT, 1904.

	Value in 1,000,000 Kr.	Value in 1,000*l.*
Copenhagen ...	4·9	270
Other towns...	2·4	130
Rural districts	6·6	370
Total ...	13·9	770

Although the total returns from the State taxes are increased by 26 per cent., the burden of the rural districts is made lighter by 8 per cent. It is evident from these figures that the agricultural class has been relieved considerably as compared with the other classes of the population.

The 13,900,000 kr. (770,000*l.*) are raised as follows:—

TABLE SHOWING INCOME TAX, PROPERTY TAX AND REAL PROPERTY TAX.

	Income Tax.		Property Tax.		Real Property Tax.		Total.	
	Value in 1,000,000 Kr.	Value in 1,000*l.*	Value in 1,000,000 Kr.	Value in 1,000*l.*	Value in 1,000,000 Kr.	Value in 1,000*l.*	Value in 1,000,000 Kr.	Value in 1,000*l.*
Copenhagen..	2·9	160	0·7	40	1·3	70	4·9	270
Other towns	1·2	70	0·4	20	0·8	50	2·4	140
Rural districts	2·2	120	1·5	80	2·9	160	6·6	360
Total..	6·3	350	2·6	140	5·	280	13·9	770

The new real property tax does not amount to more than 5,000,000 kr. (280,000*l.*), as compared with 10,800,000 kr. (600,000*l.*), which was the yield of the old real property taxes (land and building taxes).

The real property owners in the cities and towns have been relieved of taxes to the amount of 900,000 kr. (50,000*l.*) (from 3,000,000 to 2,100,000 kr.), equal to a reduction of 30 per cent.: the burdens of the owners in the country have been lightened by 4,900,000 kr. (270,000*l.*) (from 7,800,000 to 2,900,000 kr.), or by 63 per cent. The owners of large properties with high mortgages on them have gained very much, as they will have to pay but a small income and property tax.

The income tax should be the same for all people of the same financial standing; but this equality, as yet, does not exist, as many of the smaller farmers do not appear to understand that the produce of their property used for personal consumption should be reckoned as income, so that practically they are paying a less tax than townspeople of the same financial standing.

The present Taxation for State purposes.—With reference to the income tax, it will be sufficient to point out that the tax is progressive (up to 2½ per cent.), with a tax-free income of 800, 700 and 600 kr. (44*l.*, 39*l.* and 33*l.*) respectively in Copenhagen, the market towns and the rural districts, and that the taxable income comprises the total yearly income from every source in cash or goods of money value. Increase of fortune, occurring through rise in value of goods, or through inheritance, insurance money, &c., is not regarded as income, neither is capital consumed, no loans, nor daily payments, &c., received for the transaction of business on public service. From the total income are to be deducted working expenses (used to procure the income) of all kinds, the money paid in taxes, the money used for interest on mortgages, and for the repair of real properties. In the case of limited companies (who pay 2 per cent. income tax), 4 per cent. of the paid-up share capital is deducted before assessing their income.

The property (capital) tax is 0·6 kr. (8*d.*) on each 1,000 kr. (55*l.*) of property. Properties of less value than 3,000 kr. (166*l.*) are tax free when their owners do not pay income tax. By "property" is understood all sorts of real and movable effects, money bonds, capital value of rents, &c. Exceptions are made in favour of: (1) Household furniture, clothes, pictures, &c., in private use; (2) prospective rights, such as the right to an insurance sum not yet due; (3) the

capital value of rents, privileges and similar matters of wholly personal character (annuities, &c.). Debts are deducted from the property.

The basis for the assessment of the real property tax are recurrent valuations (made every tenth year, with an interval of only five years between the first two valuations.) The valuation includes the trade value of the property, but not live-stock, dead-stock, plants, &c.

As a guide for the valuers, the actual selling prices and valuations for mortgage purposes are to be used: the State tax is 1·1 kr. (14·85*d.*) for every 1,000 kr. (55*l.*) value of real property. On dwelling-houses with flats of a letting value as low as 60, 120 and 180 kr. respectively (3*l.* 6*s.*, 6*l.* 13*s.*, 10*l.*) for rural districts, towns and Copenhagen, this tax is not leviable. With regard to agricultural properties, the following sums are to be deducted from the assessed value:—

	Deduction.	
	Currency. Kroners.	Sterling. £
If the assessed sum be—		
Below 8,000 kr. (440*l.*) ...	2,000	110
Between 8,000 and 2,000 kr. (440*l.* and 660*l.*) ...	1,000	55

On houses for single families, occupied by working men, fishsermen or mechanics, without assistants, and from whose assessed value nothing is deducted in accordance with the above provisions, there is a deduction to the following extent:—

	Deduction.	
	Currency. Kroners.	Sterling. £
If the assessed sum be—		
Below 3,000 kr. (167*l.*) ...	2,000	110
Between 3,000 and 4,500 kr. (167*l.* and 250*l*) ...	1,000	55
Between 4,500 and 6,000 kr. (250*l.* and 330*l.*) ...	500	27

Finally, it should be mentioned that if any agricultural property, according to the new law, should have to pay more in State real property tax than it paid formerly in State land taxes, the new tax is to be reduced to the amount that was paid previously. This provision will, however, not apply after July 1, 1929.

The greatest advantages, however, have been conferred upon the tithe-paying farmers. The abolition of the tithes is arranged so that the tithe-owners will be entitled to receive a compeneation, which is twenty-five times the amount of the yearly paid tithes, and of this sum the State defrays seven-twenty-fifths and the former tithe-paying farmers eighteen-twenty-fifths. The subsidy from the State will amount to between 40,000,000 and 50,000,000 kr. (2,225,000*l.* and 2,750,000*l.*). The tithe-payer has the option of choosing whether he will pay the whole commutation sum in cash or half-yearly instalments of 2·25 per cent.of the said sum for 55½ years. The tithe-owner receives his money either in cash or in 4 per cent. Government bonds,

Present Local Taxation.—Local Property Tax.—The agricultural landowner is relieved, as will be seen, of State taxation at the expense of the other landowners and of the people who possess large capitals and incomes, while at the same time his local taxes are reduced. The owner of real property in the country, who does not carry on agriculture, and accordingly did not pay any local tax on his property (except in proportion to the productive power of his ground, which did not mean very much for the non-agricultural inhabitants), will now have to pay on the trade value of his property. The local land tax is abolished, and replaced by a real property tax based on the same valuation that applies to the State tax. In order that too great a revolution in the value and prices of the estates should not take place, as might be the case if both the local and the State land tax were abolished and replaced by another tax, the law provides that from 1905 one-fifth of the local real property tax is to be levied on the new basis and four-fifths as land tax, according to the old appraisement; from 1910, two-fifths on the new basis and three-fifths on the old, and so on, so that the new real property tax will not be in full operation before 1925. The principal difference between the State and the local real property tax is that certain properties of a public character, which are exempted from the State tax, can be taxed locally, and that the State tax is fixed at 1·1 per cent. of the property value, whereas the local tax will vary according to the requirements of the different parishes and counties.

Local Income Tax.—In leaving the local property tax and entering upon the question of the personal taxes, it may be worth noting that the proportion that exists in the parishes between assessment on real property and on "property and ability tax" cannot be altered to the disadvantage of the property holders, unless the alteration is decided on by a bare majority in the Parish Council and by a majority of three-fourths of the members of the County Council.

With reference to the local personal income tax ("property and ability tax") the following new main provisions ought to be mentioned:—

(1) In future the income tax is to be paid not only by persons living in the municipality (parish), but also by persons who earn their means of livelihood there. This will be of no little importance, not only for the cities, which will be able to levy taxes on persons who have their business in the city but their residence outside, but also for the parishes, where it will not be necessary to tax the land to the same extent as formerly, the landlord being no longer in a position to evade the income tax by residing outside the municipality. The provisions as to the manner in which the municipality of residence and the municipality (or municipalities) of trade are to share the tax are too detailed to be specified here.

(2) The local assessment had formerly to be based on the "whole financial position" of the person concerned, whereas in future the income used for the assessment of the State income tax will also be used as the first basis for the local income tax. The County Councils have to form rules for the assessment of the parishes according to the proposals of the Parish Councils. In the rules it can be provided that the local tax-paying income is fixed by adding to the tax-paying income for State income tax purposes: (1) Up to 50 per cent. for incomes from capital, tithes, or other perpetual rents; (2) up to 35 per cent. for incomes from real properties; (3) up to 25 per cent. of pensions, annuities, &c.; (4) up to 15 per cent. for incomes which may later on be replaced by pensions. This additional amount is to represent the same percentage for all incomes derived from the same source in the same parish. Further, it may be provided in the rules that the tax on income, fixed in this manner, can be raised in respect to any individual tax-payer, according to his ability, up to 25 per cent. on such grounds as proportionately great incomes, small family, exceptionally high profit during the last year, or special success in business. Or it can be diminished up to 65 per cent. on account of proportionately small incomes; many children, old age, sickness, great losses or failures during the last year. Incomes less than 800 kr. (44*l.*)–1,000 kr. (55*l.*) in the towns—may be diminished at the discretion of the Board of Assessment, but the tax is not to be entirely remitted. (The last provision is made in order to preserve the inhabitants' voting rights.)

The practical results of these provisions, that leave only a limited power with the Board of Assessment, cannot as yet be told.

(3.) Limited companies, co-operative societies, &c., will in future have to pay local income tax, but never more than 3 per cent. of their net profit, and in the taxation of their net profit they are relieved from such part of the tax as corresponds with that part of their gross profit, which they earn outside the country. Co-operative societies do not pay the tax, except when transacting business outside the circle of their membership, and the tax, therefore, will be of but little interest for the rural districts.

(4.) From the financial year 1904-05 the State pays 1,500,000 kr. (82,500*l.*) yearly to the local bodies. This State subsidy is distributed to the towns and the counties in proportion to figures, obtained by multiplying the total expenses for school teachers' pay, old age pensions. out and in-door relief to the towns and the counties, by the percentage which these expenses amount to in proportion to the State income and property tax as paid in the towns and counties. The counties pay half of their subsidy to the parishes on the same principle. After the commencement of 1904-05, a parish cannot assess a higher amount than was assessed in any of the years 1901, 1902 and 1903, less the subsidy, unless the Parish Council so decides by a majority of its members on two meetings held with at least a fortnight's interval.

Conclusion.—Taking it all round, the reform of taxation has undoubtedly helped to relieve the agriculturists. It is difficult to say whether the larger and the smaller agriculturists have been relieved proportionately. From several parts of the country complaints are made by the smaller farmers, but very little is heard from the larger ones, and, bearing in mind that dissatisfaction invariably arises whenever a new tax is introduced, these complaints may perhaps be regarded as of little consequence. The townspeople have more reason to be dissatisfied.

Whether the old land tax and the tithes were taxes or ground rents, their abolition has certainly made room for a more equitable system of taxation. It is difficult to say what effect the reform may have on agriculture, and it is very probable that it may have hardly any traceable effect, for with all its deficiencies the old system did not obstruct agriculture. As a matter of fact, the farmers have now succeeded in

having their taxes reduced and in having rural taxation extended to others than agriculturists.

It now remains to be seen whether the farmer will profit by the increase in value which the reduction in the taxes will bring to his land, or whether it will only lead to an increase in the mortgages. In the latter case his financial standing in a few years will be no better than it was before the reform of 1903.

THE USE OF WIND-BREAKS.

(From the *Agricultural News*, Vol. X., No. 227, January 7, 1911.)

In most parts of the West Indies, conspicuous examples can be easily found of the great degree to which the growth of plants is retarded by exposure to constant winds. The larger trees, as regards the tips of the upper branches, are shaped to slope upward from the windward to the leeward side, showing that the wind has had an action similar to that of pruning on one side of the branches only; while the herbage around them is scanty, and seems to be barely permitted to exist. Such are the conditions that obtain in regard to the ordinary, hardy plants. There is small wonder, then, that the agriculturist, when he is raising varieties of a delicate nature, and possibly of exotic origin, finds it necessary to provide protection for them against the wind. It is these circumstances that have given an origin to the important subject of the planting of wind-breaks.

Wind-breaks, or shelter belts, as they are often termed, may be either permanent or temporary, according to the nature of the crop that they are designed to protect. For perennial crops, such as limes or cacao plants that will form large trees are required. Annual crops, such as cotton and most kinds of ground provisions do not necessarily demand large or long-lived plants for purposes of protection.

The permanent wind-break, planted at the same time as the crop which it is intended to protect, grows up with this generally at a quicker rate, so that when the plants of the latter have attained maturity, the wind-break is available for their protection. Among the plants more commonly used in the West Indies in this connection are pois doux (*Inga laurina*), Madura; or Nicaragua shade tree (*Gliricidia maculata*); a quickly growing plant, galba (*Calophyllum Calaba*) which withstand sea-blasts well; savonnette (*Lonchocarpus violaceus*); white cedar (*Tecoma leucoxylon*) used more particularly in Montserrat, while bamboos have also been employed for the purpose, although their great drying action on the soil forms an objection to their extended employment.

The temporary wind-break most commonly used are Guinea corn and pigeon peas. In cotton cultivation, one or the other of these may be planted at the head of the rows, on the windward side, if the best results are to be obtained. As in the case of the permanent wind-breaks, the protecting crop grows up with the main one, and the period of its existence is more or less that of the plants which it is designed to shelter. The advantage of wind-breaks of this kind is that they can be removed when the principal crop is harvested, leaving the ground entirely clear for such cultural operations as may be necessary. They possess disadvantages on account of the fact that their sheltering action extends to a short distance, only to leeward to them, necessitating the taking up of valuable space where the area of cultivation is large by successive rows of shelter belts; and because they are of little or no use in storms or in very high winds.

It will be well to consider, at this stage, the general effects of wind-breaks. Reference has been made already to their directly protective quality, by which they prevent mechanical injury by wind. Among such damage is the breaking off of branches and the removal of flowers and fruits, by which the productive capacity of the trees is lessened, and in the first instance opportunities are given for invasion by disease. The chances of serious loss of flowers and fruits in this way are not usually great in cacao orchards; it is in citrus cultivation that greater harm is likely to accrue from this cause. In any case, the presence of a shelter belt, where this is required, lessens the stunting action of the wind, and thus removes one of the largest handicaps that have to be met by the plants in their struggle for existence.

The ways in which the wind-breaks are of use to plants are, however, generally secondary. They often serve to ameliorate the conditions under which the plants are existing, to such an extent as to enable them to attain a state of energetic healthfulness in which they resist successfully all attacks of diseases and pests; while much of the effort that would be otherwise required in combating untoward conditions is employed in

producing good crops of a useful quality. The agriculturist cannot afford to ignore these two most important aspects of the employment of shelter for plants against the wind.

The presence of belts of plants of a kind other than those which form the principal cultivation is of much use in the checking of epidemics of disease. These start in a certain place or places, and, often travelling with the wind, spread easily, because they can pass through an uninterrupted area of the very plant that is the object of their attack. If, however, a wind-break composed of a plant or plants on which a disease has little or no effect occurs in its paths, its course is interrupted, and the changes of safety of the plantations on the other side of the shelter belt are increased to a useful degree. This circumstance makes it important that wind-breaks should be chosen in consideration of their power to resist disease, and of the diseases to which they are most subject, a matter to which further reference will be made below.

One of the subsidiary results of the presence of the plants which form a permanent wind-break is that the existence of these in the soil lessens the washing that takes place at times of heavy rain, so that they possess a useful forest effect. The importance of this cannot be over-estimated, particularly where permanent crops are being grown on steep slopes in regions of heavy rainfall.

Not the least among the advantages of the existence of wind-breaks is the assistance that this gives in conserving the water in the soil, and in decreasing transpiration from the leaves of plants. Where shelter belts are found, the force of the air currents is lessened, so that the rate at which moisture is carried away from the areas over which they travel are diminished to useful degree. Wind-breaks serve also to temper the chilling effect of cool winds; this result is, however, of no great importance in the West Indies except in the more mountanious islands. A minor matter, but one worthy of mention, is that they are said to encourage the presence of birds; though whether this is of advantage or not will depend on the circumstances of the special case.

Reverting to suitable wind-breaks for crops of one season, it seems that more attention may well be given to the feasibility of providing those which are of a permanent nature. Where such provision can be made, as will have been seen from what is said above, special advantages will accrue, in that the protective effect of belts of this kind will extend over a far larger area than that which can be sheltered by a temporary wind-break, and that such protective effect will be available during storms in which the temporary belts, from their very nature, would cease to do the work that is required of them. It is recognized that there is little incentive when ground is being opened for the growing of one-season crops to plant permanent wind-breaks. Nevertheless this course is followed in some districts in the French West Indian islands, and the suggestion is made that its further adoption would be of advantage, and would make for its justification.

A final matter is to point out that care is required in the choice and planting of wind-breaks. The plants employed in them are often leguminous, because of their known property of assisting in adding nitrogen to the soil, and because the prunings from them are likely to be richer in nitrogen than those from ordinary plants. There should be the assurance that they are not subject to the diseases and pests that are most likely to attack the plants which they are designed to protect, and in planting them due regard must be had to the conditions of the estate on which they are in use, or it may be found that they have been placed in such a position in regard to the prevailing winds as to render inadequate the protection from them. Care in these matters will give the agriculturist an asset which at once increases the living energy of his plants, protects them from disease, and conserves the soil and the water that are required for their needs.

A DICTIONARY OF TERMS USED IN AGRICULTURE, BOTANY, CHEMISTRY, AND ALLIED SCIENCES:

FOR THE USE OF PLANTERS AND OTHERS.

BY J. C. WILLIS AND M. WILLIS.

(*Continued from page 463.*)

Hemp, Bow-string ... Sansevieria zeylanica, &c.
Hemp, Madras ... Crotalaria juncea
Hemp, Manila ... Musa textilis
Hemp, Mauritius. Furcrea gigantea
Hemp, Rajmahal Marsdenia tenacissima
Hemp, sisal ... Agave rigida var. sisalana
Hemp, sun ... Crotalaria juncea
Henequen ... Sisal Hemp

Henna ... Lawsonia alba
Herb ... A plant without woody tissue above ground and usually dying down after flowering
Herbaceous (stem) Not woody above ground
Do (leaf) Thin not leathery
Herbarium ... A collection of dried plants
Heredity ... Transmission of characters from parent to offspring
Hermaphrodite flower ... Flower containing both stamens and carpels
Herring bone ... Tapping by lateral channels from a central groove
Heterostyled ... With different lengths of stamens and of styles in different individuals of the same species
Hibbert bean ... (West Indian) Phaseolus lunatus
Hibernating ... Remaining quiescent during winter
Hilling ... Making hills round plants as they grow
Hilum ... Scar, where seed-stalk separates from seed
Hindi cotton ... An almost valueless sport that appears among Egyptian
Hing (Hind.) ... Asafœtida
Hippocrepiform Horse-shoe shaped
Hirsute ... With long distinct hairs
Hispid ... With rough, bristly hairs
Hispidulous ... Slightly hispid
Hogshead (ale)... 52 gallons odd
Holing ... Making holes at regular distances for the reception of young plants
Hominy ... Maize meal
Homologous ... Equivalent as regards descent
Hopper ... Receptacle
Horse bean ... (West Indian) Canavalia ensiformis
Horse-eye bean (West Indian) Mucuna urens
Horse gram ... Dolichos bilorus
Horse-radish tree ... Moringa pterygosperma
Hot bed ... Nursery bed made warm with fermenting manure
Hullah ... Depression
Huller ... Machine for breaking up the parchment layer outside coffee beans
Humic acids .. Organic acids produced from decaying vegetable matter in the soil
Humus ... Products of decaying organic matter in the soil
Hyaline ... Transparent
Hybrid ... Offspring of two distinct species
Hybridising ... Crossing of two distinct species
Hybrid tea ... Cross of China and Assam teas
Hydrocarbon ... A compound of carbon and hydrogen with the general formula $C^n H^2n + 2$
Hydrolysis ... The combining of a substance with the elements of water followed by a splitting up
Hydrometer ... An instrument for finding the specific gravity of a liquid
Hygrometric ... Moisture-absorbing
Hygroscopic ... Attracting water
Hymenoptera ... Bees, ants, wasps, etc.
Hyphæ ... Threads composing a fungus
Hyphomycetes... Fungi-bearing spores on simple or branched hyphæ. Fungi Imperfecti
Hypochil ... Basal part of lip of orchid flower
Hypocotyl ... The stem-axis below the cotyledons in an embryo
Hypogeal (germination) ... With cotyledons below ground
Hyson ... A grade of green tea
Ichneumon fly ... A parasite of caterpillars, &c.
Igneous ... Rocks produced by volcanic action
Ilami ... Ageratum
Imago ... Adult stage of an insect
Imbricate ... Overlapping, like the tiles on a roof
Immune ... Not susceptible to infection
Immunity ... Insusceptibility to infection
Imparipinnate ... Leaf with an uneven number of leaflets
Imperfect (flower) ... Of one sex only
Inarching ... Grafting in which the scion is left attached to its own roots till it has united with the stock

Incised ... With notches in the margin
Inciso-denate ... With denate notches
Included ... Not projecting
Incumbent ... A radicle lying on the back of one cotyledon, the cotyledons not being folded on themselves
Indehiscent (fruit) ... Not splitting to let out the seeds
Indefinite ... Over 20 in number and usually varying from flower to flower
Indian butter tree ... Bassia butyracea
Indian Colza ... Sinapis glauca
Indian Copal ... Vateria indica
Indian Corn ... Zea Mais
Indian Jalap ... Operculina Turpethum
Indian liquorice Abrus precatorius
Indian Madder ... Oldenlandia umbellata, Rubia cordifolia
Indian Mahogany ... Toon
Indian plum ... Flacourtia
Indian sarsaparilla ... Hemidesmus indicus
Indian Walnut ... Aleurites triloba
India rubber ... Dried latex containing Caoutchouc
Indigenous ... Native
Indigo ... Indigofera tinctoria and other species
Infectious ... Liable to transmit disease
Inferior ... Ovary completely immersed in and united to the hollow receptacle, only the styles being free
Inflated ... Enlarged in a balloon-like manner
Inflexed ... Bent inwards
Inflorescence ... Part of the plant bearing flowers
Infrafoliar ... Below the leaves
Infundibular ... Funnel-shaped
Innate (anther) Fixed to the filament by its base
Inoculation ... Intentional treatment of a subject or plant with the spores or virus of a disease to induce the appearance of the disease
Insecticide ... Substance fatal to insects
Inserted ... Placed on
Insertion ... *Of leaf*, mode of union with stem; *of parts of flower*, mode of union with the rest of the flower
Insoluble ... Not capable of dissolving
Inspissation ... Thickening by evaporation
Integument ... Coat
Internode ... Portion of stem between the points of insertion of two successive leaves
Interpetiolar ... Between the petioles
Intrapetiolar ... Within the petioles
Introrse anthers Opening towards the centre of flower
Involucel ... Small involucre
Involcurate ... Provided with an involucre
Involucre ... Whorl of bracts surrounding an inflorescence
Involucrent ... Adjective of last
Involute ... With margins rolled inwards
Ion ... Component of a chemical compound set free by electrical decomposition
Ipecacuanha ... Uragoga Ipecacuanha
Irregular flower Flower in which one or more members are missing from outer whorls, or in which the members of any one whorl are not all alike
Irrigation ... Watering of land artificially
Jackal coffee ... Berries fallen to the ground and collected at end of season
Jaggery .. Sugar produced from the sap of Arenga, Borassus, Cocos, and other palms
Jagra ... Jaggery
Jai ... Oats
Jak ... Artocarpus intergrifolia
Jalap ... Ipomœa Purga
Jambu ... Eugenia Jambos
Jannovitch ... A variety of Egyptian cotton
Janum ... Fish leaf
Jarul ... Lagerstrœmia flos-reginæ
Jasut ... Shoe flower
Jat ... Kind, class
Jatamansi ... Nardostachys Jatamansi
Jav ... Barley
Java Almond ... Canarium commune
Java radish ... A variety of radish with edible pods
Jayant (Hind.)... Sesbania aculeata
Jhara ... Rice
Jheels ... Swampy lands
Jhuming ... Chena

Jowar, jowari, juar ... Sorghum Vulgare
Jubbulpore hemp ... Crotalaria tenuifolia
Jungle rope ... A creeper used as rope
Jute ... Corchorus capsularis, C. olitorius, etc.
Jute hessian ... Gunny
Kabook, Kabuk. Laterite
Kach-Kela ... Plantain used as vegetable
Kachu (Ind.) ... Colocasia Antiquorum
Kaddy ... Small native shop.
Kadjan ... Mat roughly plaited from palm leaf
Kainit ... A mineral found in Germany, which supplies the bulk of the world's potash manure
Kala (Bengali) ... Plantain
Kamala ... Mallotus philippinensis
Kamaranga ... Averrhœ Carambola
Kamela ... Mallotus Philippinensis
Kanakkapulle ... Accountant
Kanda ... Onion
Kang, Kangu ... Setaria italica, Millet
Kangani ... Overseer
Kankar ... Lime-stone nodules
Kanoff ... Hibiscus cannabinus
Kanthal ... Jak
Kapas ... Cotton
Karala ... Niger seed, Guizotia abyssinica
Karambola ... Averrhoa Carambola
Karet rubber ... Ficus elastica
Katira ... Gum of Astragalus
Katti ... Knife
Keel ... A boat-shaped structure formed by union of the two anterior petals in Leguminosæ
Keeled ... Having a keel
Kela ... Plantains used as fruit
Kerosene emulsion* ... Soap ½ lb.
Kerosene 2 gals.
Soft water 1 gal.
Kew pine ... Smooth Cayenne variety of pine
Khair ... Acacia latifolia
Khaka siris ... Albizzia Lebbek
Khaki ... Cotton stuff dyed with Cutch
Khaki Cotton ... A yellowish coloured variety of cotton
Kharif ... Rains crop
Khas khas ... Opium
Khor ... Acacia Senegal
Kheinti ... Second cutting of indigo

*Dissolve the soap in the water heated to boiling, add the Kerosene, and churn till a creamy fluid results. For use add 1 part to 10 of water.

Khurpa ... Weeding hook
Kiong bean ... Phaseolus Vulgaris
Kilingu ... Young plant of Palmyra palm
Kino ... A resin-like substance, soluble in water, an astringent, used in medicine and in tanning
Kiryat (Hind.) ... Andrographis Paniculata
Kist (Hind.) ... Land Revenue
Kitul ... Caryota urens
Kling ... A Tamil (Straits Settlements)
Knol-kohl ... Brassica oleracea, var.
Kodo ... Paspalum scrobiculatum
Kodo millet ... Paspalum scrobiculatum
Kodra ... Paspalum scrobiculatum
Kola ... Cola acuminata, etc.
Kulthi, Kulthi-Kalai ... Dolichos biflorus, horse-gram
Kumbu ... Pennisetum typhoideum
Kumgnat ... Citrus Japonica
Kungu ... Panicum miliare
Kunkur ... Kankas
Kurakkan ... Eleusine Coracana
Kurchi bark ... Holarrhena dysenterica
Kurumba ... Unripe coconut containing fluid
Kuruni ... About ⅛ bushel; or extent of land that can be sown with it
Kusum ... Safflower, Carthamus tinctorius
Laboratory ... Building equipped for scientific work
Lac ... A resinous secretion from the lac-insect, Tachardia
Lace ... A form of prepared rubber
Lacerate ... Deeply and irregularly divided
Laciniæ ... Long segments
Laciniate ... Divided into several long segments
Lac insect ... Tachardia sp.
Lacuna ... Air space in tissue
Ladang ... Chena, 6 V.
Lady's fingers ... Bandakai
Lageniform ... Flask-shaped
Lagos rubber ... Funtumia elastica
Lalang ... Illuk, Imperata arundinacea
Lamellate ... Made up of thin layers
Laminated ... Composed of plates
Lanceolate ... About 3 times as long as broad and tapering gradually towards the tip

Lang ... Lathyrus sativus
Lantana bug ... Orthezia insignis (scale insect)
Larva ... The early stage of an insect
Laterite ... Red friable soil, common in the tropics
Latex ... The milky juice of a plant
Laticiferous ... Latex-bearing
Layering ... Pegging down and partly burying a branch to form a new plant
"Leaf" ... Plucked tea
Leaflet ... One of the blades of a compound leaf
Leaf-scar ... Scar whence a leaf has fallen
Lechuguilla ... Agave fibre
Legume ... A pod opening on both sides; characteristic of family Leguminosæ
Leguminous ... Belonging to Leguminosæ
Lemongrass ... Cymbopogon citratus
Lenticel ... An opening in the bark, filled with powder through which respiration goes on
Lenticular ... Lens-shaped
Lentil ... Lens esculenta
Lepidoptera ... Butter flies and moths
Lesion ... Injury
Letpet tea ... A peculiar kind of tea made in Burma
Lettuce ... Lactuca sativa
Levee ... A bund along a river
Liane ... A woody climber
Life-history ... Details of the various stages through which the life passes
Ligulate ... Strap-shaped
Lima bean ... Phaseolus lunatus
Lint ... The free part of a united calyx, etc.
Lime ... Citrus medica, var. acida
Linear ... Line-shaped
Lineate ... Marked with lines
Lines ... Coolies' dwellings
Lining ... Marking out in lines for planting
Linseed ... Linum usitatissimum
Lint ... Cotton after removal of the seed
Lip ... A lower petal forming a flap to a flower
Liso ... A variety of cacao
Litre ... A French measure of capacity = 1·76 pints
Litter ... Material used for bedding animals
Littoral ... On the beach
Loam ... A soil intermediate between sand and clay
Lobed ... Divided into proportionately large segments at the outer end
Lobster caterpillar ... Stauropus alternus
Lobulate ... Diminitive of lobed
Locullus ... A compartment
Loculicidal ... Splitting down the centre of each cavity
Locust ... Various species of grasshoppers
Lodicule ... A little scale in a grass flower
Logwood ... Haematoxylon campechianum
Lomentum ... A pod constricted between the seeds, *e.g.*, that of Acacia decurrens
Longicorn ... A family of beetles characterized by long antennæ
Lorate ... Strap-shaped
Loriform ... Strap-like
Love grass ... Andropogon aciculatus
Love lies bleeding ... Amaranthus spp.
Loxa bark .. Cinchona officinalis
Lumber ... Cut timber
Lunate ... Half-moon-shaped
Lye ... Solution of alkali
Lyrate (leaf) ... Like that of mustard
Macaw palm ... Acrocomia fusiformis
Mace ... The aril of the nutmeg
Maceration ... Soaking in water till decay of the softer parts sets in
Macropodous ... With cotyledons
Madar ... Calotropis gigantea
Madar ... Erythrina indica
Madder, Indian Rubia cordifolia
Madre de cacao Erythrina umbrosa
Maggot ... Legless larva of a fly
Maguey ... Agave americana
Mahua, Mahwa Bassia latifolia
Maize ... Zea Mais
Maka, Makkai (Ind.) ... Maize
Mal ... Prepared indigo after beating
Malabar Tallow Vateria indica
Malay apple ... Eugenia malaccensis
Male Bamboo ... Dendrocalamus strictus
Malle ... Gardener
Malt ... Partly germinated grain
Mamilla ... One of the cushions in Cacti
Mamilliform ... Cushion like
Mamote ... A digging hoe
Mana ... Cymbopogon confertiflorus

Manchineel ... Hippomane Manchinella
Mandar (Hind)... Erythrina indica
Mandioca ... Manioca
Mangabeira rubber ... Hancornia speciosa
Mango ... Mangifera indica
Mangosteen ... Garcinia mangostana
Manicoba rubber Manihot
Manila hemp ... Musa textilis
Manila nut ... Ground nut
Manioca ... Tapioca, Manihot utilissima
Manipur tea ... A variety of tea
Manjib (Ind.) ... Rubia cordifolia
Manna ... Dendrocalamus strictus
Manure, green ... Plants grown between the main crop and cut or ploughed in
Maragogipe ... An upland Brazilian variety of coffee
Maravuli ... Cassava
Marble wood ... Diospyros Kurzii
Marcescent ... Withered but not falling
Marl ... Soft chalky clay rock
Mast wood ... Calophyllum Inophyllum
Masua ... Lentil
Maté ... Tea of Ilex paraguayensis
Math (Ind.) ... Phaseolus aconitifolius
Matico ... Piper angustifoliuim
Matikalai ... Phaseolus Mungo
Maund ... 80 lbs.
Mauritius grass.. Panicum muticum
Mauritius hemp. Furcræa gigantea
Mauritius pine ... A variety of the pineapple
Mealy bug .. Scale-insects of the family Dactylopiinæ
Medeloa ... Dalbergia assamica
Medium plucking Taking bud and three leaves
Medullary ray ... Ray of soft tissue running through the wood of a stem
Megass ... Refuse after crushing sugar cane
Melegueta pepper ... Amomum Melegueta
Membranous ... Like a membrane of thin tissue
Mendel ... The author of the researches upon which recent progress in breeding is based
Mendelism ... Study of breeding, etc. upon Mendelian lines
Mentum ... Extension of foot of column in Orchids
Mercerising ... Treatment of cotton with caustic soda to give it silky appearance
Mericarps ... Portions into which some fruits split up without dropping the seed
Mesocarp ... Intermediate layer of fruit wall
Mesophyll ... Central tissue of leaf
Metabolism ... Chemical change of food, etc., within the plant
Met afiffi ... A variety of Egyptian cotton
Metamorphic ... Rocks that have undergone serious alteration
Metamorphosis.. Change of structure
Meter, Metre ... A measure of length, 39'37 inches
Mexican rubber Castilloa elastica
Micro-organism A microscopic living organism
Micropyle ... Opening into a seed
Mildew ... A superficial fungus growth
Milk bush ... Euphorbia tirucalli
Milk tester .. A machine to test the amount of fat in milk
Millet ... Panicum, Sorghum, etc.
Millimetre ... One-thousandth of a meter
Millipede ... Myriapoda with 3 pairs of limbs on each joint of the body (Centipedes have only 1 pair)
Mirchi ... Chilli
Miri ... Pepper
Mita-alu ... Sweet-potato
Mixed gardens ... See Willis, Agriculture in the Tropics, p. 132
Molasses ... The syrupy liquid left after the crystallization of sugar
Monadelphous ... In one bundle
Monandrous ... With one stamen
Moniliform ... Like a row of beads
Monkey nut ... Ground-nut
Monœcious ... With male and female flowers on the same plant
Monochlamydeous ... With only calyx or corolla, not both
Monocotyledon Plant with one Cotyledon
Monotypic ... Genus with one species
Mordant ... A substance causing a dye to remain "fast"
Morhun ... First cutting of indigo
Mosaic disease A disease of tobacco of somewhat doubtful origin and cause

Mosquito blight of tea	... Helopeltis theivora and H. Antonii
Mould board	... The part of the plough which turns over the furrow-slice
Moulmein cedar	Cedrela Toona
Mountain papaw	Carica candamarcensis
Mowha	... Bassia latifolia
Mucronate	... With sharp terminal point
Mug (Ind.)	... Phaseolus Mungo
Mukalana	... Virgin forest
Mulch	... Anything laid on the soil to hinder evaporation
Muli (Ind.)	... Radish
Multivoltine	... With many broods in a year
Mungh-phali (Ind.)	... Groundnut
Munj	... Saccharum arundinaceum
Munj fibre	... Leaf-sheaths of Saccharum arundinaceum
Muricate	... Rough with short firm outgrowths
Muriform	... Wall-like
Muscovado	... Raw sugar
Musk melon	... Cucurbita moschata
Mustard	... Brassica sp.
Mutation	... Sudden change
Muticous	... Blunt
Mycelium	... Body of a fungus
Mycologist	... Student of fungi
Mysore thorn	... Cæsalpinia sepiaria
Myxomyceto	... A slime fungus
Nagli (Ind.)	... Kurakkan
Nagphana	... Opuntia Dillenii
Name	... Entry on the check-roll
Nase-berry	... Sapodilla
Nashtar	... Knife for cutting opium.
Natal Java indigo	... Indigofera arrecta
Navel orange	... A variety of orange
Navicular	... Boat-shaped
Nebong palm	... Oncosperma filamentosa
Nectary	... A honey-gland
Nelu	... Strobilanthus
Nematode	... An eel-worm
Nettle grub	... Caterpillars of a family of moths (Limacodidæ) with stinging spines
Neuter	... Neither male nor female
Nibs	... Shells of cacao beans
Nicotine	... An alkaloid in tobacco
Nidus	... Substratum
Niger seed	... Geezotia abyssinica
Nil, Nila	... Indigo
Nilgiri nettle	... Girardinia hetrophylla
Nim	... Nelia Azadirachta
Nitrification, Nitrifying	... Production of nitrites in the soil by a micro-organism
Nitrogen-fixing organs	... The micro-organisms of Leguminosæ, etc., that cause absorption of nitrogen from the air
Node	... Joint of a stem, where the leaves are attached
Nodose	... Knobby
Nodules	.. Little knots on roots of Legumincsæ, inhabited by nitrogen-absorbing bacteria
Nucleus	... Central portion of a cell
Nullah	... Ravine, dry for part of the year
Nut	... Hard not-opening fruit
Nutmeg	... Myristica fragrans
Nutrient solution	Solution containing the necessary food materials for growth
Nympha	... An immature insect
Oblong (leaf)	... Sides parallel, ends tapering rapidly
Obovate	... Ovate with large end outwards
Obsolete	... Rudimentary or wanting
Obtuse	... Blunt-ended
Ocellate	... With a circularpatch of colour

(*To be continued.*)

Correspondence.

PADDY CULTIVATION IN CEYLON DURING THE XIXTH CENTURY.

Derryclare Estate,
Kotagala, Ceylon.

SIR,—In Mr. E. Elliott's article in October "*T.A.*" on "Paddy Cultivation in Ceylon during the XIXth Century," I note he mentions a "Mr." Rodney. This is evidently meant for my maternal great-grandfather, Captain the Hon'ble John Rodney, R.N., who was Colonial Secretary of Ceylon from, I think, 1806 to 1833. He was a Captain in his own right as also an Hon'ble, having been in the Navy prior to coming out to Ceylon, and being the third son of Admiral Lord George Brydges Rodney, R.N.

Yours faithfully,
J. R. MANNERS.

28th October, 1911.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Monthly Prices Current, London, 11th October, 1911.)

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine ...	67s 6d a 72s 6d
Zanzibar & Hepatic ,,	Common to good ..	40s a 7[illegible]s 6d
ARROWROOT (Natal) lb.	Fair to fine ..	8d a 9d
BEES' WAX, cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair ...	£6 12s 6d a £6 15s
East Indian, bleached ,,	Fair to good	£7 15s a £8
,, unbleached ,,	Dark to good genuine ..	£5 15s a £6 7s 6d
Madagascar ,,	Dark to good palish	£6 10s a £6 17s 6d
CAMPHOR, Japan ,,	Refined	1s 5¾d a 1s 8d
China ,,	Fair average quality ...	140s
CARDAMOMS, Tuticorin	Good to fine bold	2s 11d a 3s 3d
	Middling lean	2s 5d a 2s 8d
Malabar, Tellicherry	Good to fine bold ...	2s 9d a 3s 3d
Calicut	Brownish ..	2s 3d a 2s 7d
Mangalore ,,	Med brown to fair bold	2s 10d a 3s 7d
Ceylon, Mysore ,,	Small fair to fine plump	2s [illegible]d a 3s 7d
Malabar	Fair to good ...	1s 11d a 3s 2d
Seeds, E. I. & Ceylon ,,	Fair to good ..	2s 7d a 2s 8d
Ceylon Long Wild ,,	Shelly to good ..	6d a 1s 6d
CASTOR OIL, Calcutta ,,	Good 2nds .	3½d a 3⅝d
CHILLIES, Zanzibar cwt.	Dull to fine bright ...	40s a 45s
CINCHONA BARK.—lb. Ceylon	Crown, Renewed	3⅜d a 7d
	Org. Stem	2d a 6d
	Red Org. Stem	1¼d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts per lb.	Good to fine quill	6½d a 1s 5d
2nds	,, ,,	5¾d a 1s 4d
3rds	,, ,,	5d a 1s
4ths	,, ,,	4½d a 8½d
Chips, &c..	Fair to fine bold	2⅜d a 3d
CLOVES, Penang lb.	Dull to fine bright pkd.	11d a 1s 2d
Amboyna ..	Dull to fine	9d a 10d
Ceylon ..	,, ,,	9d a 10d
Zanzibar	Fair and fine bright	8d a 8¼d
Stems ..	Fair	3d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	80s a 113s
Native	Good ordinary	Nominal
Liberian ,,	Fair to bold	70s a 78s
COCOA, Ceylon Plant. ,,	Special Marks	75s a 85s 6d
	Red to good	65s a 73s
Native Estate ,,	Ordinary to red	43s a 64s
Java and Celebes ,,	Small to good red	25s a 80s
COLOMBO ROOT ,,	Middling to good	15s a 20s
CROTON SEEDS, sift. cwt.	Dull to fair	70s a 75s
CUBEBS ,, ,,	Ord. stalky to good	160s a 170s
GINGER, Bengal, rough ,,	Fair	35s nom.
Calicut, Cut A ,,	Small to fine bold	80s a 85s
B & C ,,	Small and medium	60s a 70s
Cochin Rough ,,	Common to fine bold	40s a 45s
	Small and D's	40s
Japan ,,	Unsplit	37s
GUM AMMONIACUM ,,	Ord. blocky to fair clean	40s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£15 a £16
	,, ,, little red	£12 a £14
	Bean and Pea size ditto	75s a £12 10s
	Fair to good red sorts	£7 a £10
	Med. & bold glassy sorts	£5 a £7
Madagascar ,,	Fair to good palish ...	£4 a £8 15s
	,, ,, red ...	£4 a £7 10s
ARABIC E. I. & Aden ,,	Ordinary to good pale	40s a 50s nom.
Turkey sorts ,,		50s a 65s
Ghatti ,,	Sorts to fine pale ...	35 a 45s nom.
Kurrachee ,,	Reddish to good pale ...	30s a 40s ,,
Madras ,,	Dark to fine pale ...	30s a 40s ,,
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£18 10s a £21 5s
	com. stony to good block	25s a £15
KINO	Fair to fine bright	9d a 1s
MYRRH, Aden sorts cwt	Middling to good	52s 6d a 60s
Somali ,,	,, ,,	50s a 52s 6d
OLIBANUM, drop ,,	Good to fine white	45s a 50s
	Middling to fair	35s a 40s
pickings ,,	Low to good pale	12s 6d a 27s 6d
siftings ,,	Slightly foul to fine	20s a 22s 6d
INDIA RUBBER lb.	Fine Para bis. & sheets	4s 9d
	,, Ceara ,, ,,	4s 6d
Ceylon, Straits, Malay Straits, etc.	Crepe ordinary to fine..	4s 6d a 4s 9d
	Fine Block ..	4s 9d
	Scrap fair to fine ..	4s a 4s 1d
Assam	Plantation ..	4s
	Fair II to ord. red No. 1	3s a 3d 8d
Rangoon	,, ,,	1s 9d a 2s 3d

	QUALITY.	QUOTATIONS
INDIARUBBER (*Contd.*)		
Borneo	Common to good	1s 3d a 2s 3d
Java	Good to fine red .	3s 6d a 3s 9d
Penang	Low white to prime red	1s a 2s
Mozambique	Fair to fine red ball ...	3s 3d a 3s 8d
	Sausage, fair to good ..	3s 6d a 3s 10d
Nyassaland	Fair to fine ball ...	2s 9d a 3s [illegible]d
Madagascar	Fr to fine pinky & white	2s 6d a 3s
	Majunga & blk coated ..	2s a 2s 2d
	Niggers, low to good ..	6d a 3s
New Guinea	Ordinary to fine ball ..	2s 6d a 3s
INDIGO, E.I. Bengal	Shipping mid to gd violet	3s 2d a 3s 8d
	Consuming mid. to gd.	2s 8d a 3s 1d
	Ordinary to middling	2s 5d a 2s 8d
	Oudes Middling to fine	2s 6d a 2/8 nom.
	Mid. to good Kurpah	2s 2d a 2s 6d
	Low to ordinary	1s 6d a 2s
	Mid. to fine Madras	None here
MACE, Bombay & Penang	Pale reddish to fine	2s 3d a 2s 6d
per lb.	Ordinary to fair	2s a 2s 2d
Java	,, ,, good pale	2s a 2s 4d
Bombay	Wild	4d a 5d
MYRABOLANES, cwt	UG and Coconada	4s 6d a 5s
Bombay ,,	Jubblepore	4s 6d a 6s 3d
	Bhimlies	5s a 6s 6d
	Rhajpore, &c.	4s 6d a 5s 9d
Bengal ,,	Calcutta	3s 9d a 4s 3d
NUTMEGS— lb.	64's to 57's	10d a 1s
Singapore & Penang ,,	80's	6½d a 7d
	110's	5¼d
NUTS, ARECA cwt.	Ordinary to fair fresh	14s a 16s
NUX VOMICA, Cochin	Ordinary to good	9s 6d a 11s
per cwt. Bengal	,, ,,	7s 6d a 8s 6d
Madras	,, ,,	8s a 9d
OIL OF ANISEED ,,	Fair merchantable	5s 2d
CASSIA ,,	According to analysis	3s 4d a 3s 7d
LEMONGRASS ,,	Good flavour & colour	4½d
NUTMEG ,,	Dingy to white	1½d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	2⅛d a 1s 4d
CITRONELLE ,,	Bright & good flavour	11⅞d
ORCHELLA WEED—cwt		
Ceylon ,,	Fair ..	10s
Madagascar ,,	Fair ...	10s
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair ...	5¾d
Ceylon ,, ,,	,, to fine bold heavy ..	5¼d a 6d
Singapore ..	Fair	5¼d
Acheen & W. C. Penang	Dull to fine	5½d a 6d
(White) Singapore ,,	Fair to fine	8d a 9d
Siam ,,	Fair	7¾d
Penang ,,	Fair	7½d
Muntok ,,	Fair	8¾d
RHUBARB, Shenzi ..	Ordinary to good ..	1s 2d a 2s 6d
Canton ..	Ordinary to good ..	10d a 1s 1d
High Dried..	Fair to fine flat ...	8½d a 9½d
	Dark to fair round ..	5½d a 7½d
SAGO, Pearl, large ...	Fair to fine	18s a 19s
medium .	,, ,,	17s a 18s 6d
small ...	,, ,,	14s a 15s
SEEDLAC cwt.	Ordinary to gd. soluble	52s 6d a 72s 6d
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 7d
	Fair greenish	3d a 4½d
	Commonspeckyand small	1¾d a 2½d
SHELLS, M. o'PEARL—		
Egyptian cwt.	Small to bold ...	77s 6d a 165s
Bombay ,,	,, ,, ...	45s a 167s 6d
Mergui ,,	,, ,, ..	£10 12/6 a 14 2/6
Manilla ,,	Fair to good ..	£8 a £14 2/6
Banda ,,	Sorts	21s 6d a 29s 6d
TAMARINDS, Calcutta..	Mid. to fine bl'k not stony	10s a 12s [nom.
per cwt. Madras	Stony and inferior ..	4s a 5s
TORTOISESHELL—		
Zanzibar, & Bombay lb.	Small to bold ..	11s 6d a 28s
	Pickings	8s 6d a 21s
TURMERIC, Bengal cwt.	Fair	22s 6d
Madras ,,	Finger fair to fine bold [bright	25s a 27s
Do. ,,	Bulbs	18s
Cochin ,,	Finger .	18s
	Bulbs ..	14s
VANILLOES— lb.		
Mauritius ... } 1sts	Gd crystallized 3½ a 8½ in	15s a 20s
Madagascar ... } 2nds	Foxy & reddish 3½ a ,,	14s 6d a 17s
Seychelles ... } 3rds	Lean and inferior ...	13s 6d a 14s 6d
VERMILLION ..	Fine, pure, bright	3s
WAX, Japan, squares	Good white hard ...	40s

THE SUPPLEMENT TO THE

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BAMBOO FOR PAPER MAKING.

POSSIBILITIES OF ANOTHER EASTERN INDUSTRY.

There is not 30 years' supply of wood for papermakers' pulp left in North Europe and America. The price of pulp is jumping. The demand for paper is increasing by leaps and bounds, and a famine in wood pulp from the world's northern forests is inevitable. Whole countries have been placed on the first stage of the dread road that ends in such deserts as those of Central Asia, by the short-sighted greed of the lumber interest. One fear, however, that of a universal famine in paper, is now being dispelled. The news is the more welcome because it is coupled with the hope that the destruction of our woodlands may also be stayed, and that wisdom may in time lead to reafforesting. Bamboo forms an excellent material for the manufacture of paper and this is already being turned to commercial account. Mr. R W Sindall, a consulting chemist and wood pulp and paper expert, who, in 1904, made an enquiry into the possibility of making paper-pulp and paper in Burma, proved that from the bamboo an excellent pulp could be made and that it could be exported to England at a price that should prove exceedingly remunerative. A difficulty has been in the bleaching, but this has now been obviated. Treated by the ordinary bi-sulphate process and by a new method simple and inexpensively bleached, it yields, it is stated, an excellent pulp, felting readily, and producing a paper pliant, resistant, and opaque, of enduring colour, thicker than other paper of the same weight, and forming one of the very finest materials for writing and printing, and of exceptional value for engraving. In order that all these excellent qualities may be preserved in the paper, however, it is essential that no part of the preparatory treatment of the pulp is carried out away from the district where the bamboo grows. Mr. H Vincent, an American expert, estimates that, under intelligent administration of cheap tropical labour, the cost of a ton of bleached pulp should not exceed £6, and that it should be worth, at an extremely modest estimate, £10. Mr. Sindall calculated the cost of a ton of unbleached Burma pulp landed in London or Liverpool at £7 10s. Having regard to the quality of the pulp, he thought that a much higher price would be secured for it in the London market, as ordinary wood pulp realised from £8 to £9 per ton. Roughly, therefore, it costs as much to put a ton of unbleached Burma pulp on the English market as it would cost by Mr. Vincent's scheme to produce a ton of bleached pulp at the factory in the Panama zone.

It would seem, then, that the planting of bamboos for paper-making is an undertaking which might well be started. It is thought that if paper were supplied from the tropics, instead of from the present sources, it will involve a considerable readjustment of the pulp industry, and the solving of many questions, among which that of labour will not be the least. This is considered in some quarters to be an objection to the growing of bamboos. It is a mistake, however, so to regard it. If bamboo comes to the rescue, it will go far to save the forests, which, if bamboo or other material be not used, will become so thinned that there will be no industry to re-adjust. It will also bring down the price of paper.

It remains to be seen if the industry is one which might be undertaken in Ceylon. It certainly is. Many, all, one may say, of the low-country districts of Ceylon are eminently suitable for the growth of the bamboo, which can be cultivated like any garden crop. After being cut down, the grasses, or rods, grow up again in about two years. Ceylon has the climate for the growth of the product, the labour for its transformation into pulp, and the

water necessary for its manufacture. Machinery can, of course, be provided. Mr. T. P. Masilamany, of Jaffna, in a recent article in the "Morning Leader" of this town, gave particulars of the cost of a plant, the expense of working it, and of the estimated profits, which he put down at 24 per cent. per annum. The figures he gives have every appearance of reliability, and it would thus seem that still another may be added to the long list of tropical and Ceylon industries. If Ceylon does not wish again, as in the case of rubber, to remain behindhand, she must hasten, for the idea is at present being vigorously pushed in Indo-China, by an Anglo-French Company, a representative of which passed through Colombo a short time ago. The work is being undertaken on a very big scale, the very latest things in machinery have been provided, and they are absolutely confident of producing very large quantities of paper within a very short time. The growth of bamboos for the production of paper is certainly worth the attention of Ceylon capitalists.

PLANTING IN JAVA AND TRAVANCORE.

TEA-RUBBER-COCONUTS-COFFEE.

Mr. C. E. Welldon has just returned from a very interesting visit to Java, Sumatra, Johore and the Malay States seeing much of Robusta Coffee, Tea, Rubber and Coconuts. He was greatly impressed with the tea in Java and considers that Para rubber in suitable districts in Java will be as good as any rubber in Sumatra or the Straits. Fever on some of the best plantations has been severe, but all possible provision is made for the health of the Managers, employes and coolies. He was struck with the yield of coconuts in Sumatra and Java and expects more land will be planted up with this product, He stated that the profits on Robusta Coffee in East Java are very large and that up to date leaf-disease has not done harm and is not reducing the crops so we may hear more of this product during the next few years.

TOBACCO IN CEYLON.

A WARNING TO THE SANGUINE.

After the recent discussion at the Agricultural Society we asked Mr. Vollar (so long of the Doombera Valley) to give us his opinion and he kindly writes :—" I can give you very little information about tobacco as a paying industry in Ceylon. My experience was the only one that ever made anything out of it—if even by myself. The German (experts) who bought the crop from me and looked after the curing made a loss, I should say, of £10,000.—I should say the Ceylon climate is unsuitable for growing the wrapper leaf—it grows too rank, and the strange thing is that seed taken from plants of imported seed reverts—if not the first year in the second—to the coarse indigenous Ceylon tobacco. Hence nothing, I think, can be made with the 'weed'—I *burn* a lot of it myself."

RUBBER TAPPING.

THE SHERIDAN-PATTERSON IMPROVED PROCESS.

Warwick, Ambawella, Oct. 18th.

DEAR SIR,—A little over twelve months ago you published a letter from me describing a new system of tapping which I had started. Its claim to originality was based on the system allowing for the annual increment in girth of the rubber tree and in substituting dividing the tree into thirds, instead of into fourths, as had then been proposed in the Straits and by Professor Hans Fitting, so that there might always be a strip of untapped bark, or bark not less than four years old to perform the functions necessary for the nutriment of the tree.

In dividing a young tree directly into fourths or even into thirds, I found the strip of bark available for tapping too small on a tree 18 in. in girth at three feet from the ground, so I devised the method which I attempted to describe in my letter. Briefly the system was to take any tree of 18 in. or even 16 in. in girth at 3 feet, and to divide it into half, and then with two or three cuts at a foot apart to tap out this section which should take twelve months. At the completion of the 12 months the tree would have increased in girth and be from 22 inches to 24 inches at 3 feet from the ground. I then proposed taking another 2 or 3 cuts above the previous cuts and carrying on for another twelve months, by which time the tree would have increased a further four to six inches. My idea then was to take 2-3rds of the untapped half, and mark it out from the bottom with two or three cuts as before, and tap it out, and when this was completed go up above these cuts with another two or three cuts again. The tree would then have been tapped four years and still have an untapped section. The fourth year's tapping would then be over this untapped section (which is the third of the second half of the tree, of which 2-3rds is tapped out) and over one-third of the originally tapped half, the tree then being divided into 1-3rd for evermore.

The practical adaptation of this system has shown that it works out well, but it is found better to only put two cuts on the first half, then when this is tapped out to divide the other half of the tree into 2-3rds and put two or three cuts on this 2-3rds section giving another year's work. When this is completed, say in twelve months' time, if the renewed bark of the first year's tapping is sufficiently good, the 1-3rd of the second half that is intact, and 1-3rd of the first year's section, can be taken straight away and the tree is divided into thirds. But if, as is most probable, the renewal of the first section tapped is not considered sufficiently recovered, then put on two or three cuts above the second year's tapping and carry on for another twelve months by when the first section tapped will be good enough in almost all cases to have 1-3rd of its area taken in, and the 2-3rds left will be sufficiently renewed to perform all the necessary functions of the bark, which necessity is being so entirely ignored by many systems of tapping

now in vogue which take half of the tree one year and half the next, and so on. Once the tree is got into sections of three, which will I think generally prove to be in three years in the best districts, and four years where bark is thinner (or at higher elevations or in dry zones) the 1-3rd section will be tapped each year, so that there will always be on the tree a strip of bark of not less than 1-3rd of its circumference which is at least two year old renewal and the system is elastic because never more than 3 cuts will be put on at a time so that at any time a section can be gone above for another year making the other sections a year older. The system, therefore, has the advantage of enabling a young tree to be profitably tapped when 16 in. to in girth at three feet from the ground, and it adapts itself to any district or elevation, and the period of renewal can be extended from 3 years to 6 years as desired. That the tapping above after the first or second year makes no reduction in yield is proved by yields secured from fields where the system is in vogue. It even appears that the leaving of the untapped section increases the yield and in any case it must prove beneficial to the tree,— I am, &c.,

J. SHERIDAN PATTERSON.

II.

Warwick, Ambawella, Dec. 3rd.

SIR,—Mr Petch in his very instructive book "The Physiology and Diseases of Hevea Brasiliensis" says that : "the adoption of the quarter system, necessitates waiting until the trees are six to eight years old before a quarter section is sufficiently large to be worth tapping," and I consider that there is the same objection to the one third section until a tree is six years old any how."

Mr Petch in referring to my system, in which I get over these objections by starting on half the tree in the 4th or 5th year, or whenever it is 16" in girth at three feet from the ground, considers that I anticipate too great an annual increase in girth and quotes Mr Willis as stating that "no estate had reached an annual average increase of four inches, and the best was three-and-a-half." How Mr Willis got his figures of all Ceylon Estates, and which he considers the best, I do not know, but I have received the following figures as to one estate, which though they may be exceptional, support my contention as to the effect of cultivation on Rubber when it is 4 to 5 years old. These trees have never been tapped on both sides, which may partly account for the very satisfactory growth. They were tapped on one side only the first year, and are being tapped on 2/3rd of the remaining side in the second tapping. The average rate of increase between 1909 and 1910 is given as follows ;—

No.		Acres.		Inches.
1	field	48	(1905 planting)	... $4\frac{3}{4}$
2	,,	25	,,	... 5
3	,,	16	(original figures missing)	
4	,,	25	,,	... 6 4-5
5	,,	29	,,	... 6

Also an 8-acre field increased 5 2-5 inch—a 3-acre field 5 3-5 inch and an 8-acre field $6\frac{3}{4}$ inch. All these fields were manured in 1908, and kept quite clean. On an adjoining estate a manured plot planted in 1906, and manured in 1909, increased in girth 5 inches in 9 months, at the rate of 6 2-3 inches in 12 months. I quote these figures to show that anyhow on some estates, with certain treatment, a 5-inch annual increment in girth may be obtained in the fourth, fifth and sixth years, which are all that my system is concerned with. Even if the increase were only 4 inches, it would not render the system unsuitable, as I only tap up to 27 inches on the lower side of the cut and to 30 inches on the upper.

Mr. Petch's second objection, is to tapping for two years on one side, both as affecting the food supply and the yield. I found by experience that there was this objection, before reading Mr. Petch's criticism, and I altered the system, so that in the second year I now tap 2-3rd of the untapped half (which is 1-3rd of the whole tree) only putting on two cuts as before, as I find that when trees are young, the fewer the cuts the better the flow continues. On page 94 of his book Mr. Petch states that "the greater number of wounds interferes more with the flow of latex and causes a more rapid diminution of yield." I proved to my own satisfaction in 1908, that on old trees (say 8 to 12 years old) 3 cuts at the foot apart, gave practically as much latex as 6 cuts at the foot apart, and of course the economy of bark is obvious. On young trees I found 2 cuts gave practically as much as 3 cuts. In my revised system, the third year's tapping can be either above the 1st year's tapping or include the still untapped section according to the girth of the tree, and the state of the renewed bark. My contention is, that on this system, you can adapt your period of renewal to local conditions, if 5 years renewal is necessary, you can get 5 years. If 4 years is necessary, you can get 4 years, whereas if only 3 years is found necessary then you have your tree easily arranged into thirds. In the meantime you have been able to tap the tree profitably without doing any harm, when only 16in in girth at 3 feet. Good 5-year-old rubber tapped on this system is yielding 150 lb per acre, 6 year-old rubber 200 lb and 7-year-old rubber 300 lb, planted mostly 15 feet by 15 or $16\frac{1}{2}$ feet by $16\frac{1}{2}$.

I am glad to see that Mr Petch emphatically condemns the use of the pricker, excepting as a makeshift in such places as Hevea Brasiliensis ought not to have been planted, and emphasises the damage being done by tapping one side of a tree one year and the other side the next, pointing out that the damage done by such systems, though not immediately apparent, will show up in future years, if a long enough renewal is not allowed.—I am, &c.,

J. SHERIDAN PATTERSON.

III.

Dec. 7th.

SIR,—I must say that I think Mr. Sheridan Patterson deserves the thanks of the Rubber-planting community for publishing the results of his observations and experience in connection with his improved system of tapping

rubber trees. I feel sure there is a great deal yet to be learned about the proper harvesting of the latex in different districts and at different altitudes in Ceylon, and the more notes of actual experience we can get together the better.--Truly yours,

PROPRIETOR.

[There can be but one opinion held among experts who have extended practical knowledge of all the various methods of extracting latex, and who have given Mr Patterson's method the trial it deserves. There are methods of tapping that destroy the tree almost as surely and rapidly as the barbarous fashions obtaining in parts of Africa and America. The Patterson system of tapping the tree in sections, allowing for increase in girth, and taking, as circumstances demand, from four to five years in working round the bole, permitting the fullest bark renewal and sap supply, secures at once a copious flow of latex, and preserves the health and power of growth of the tree. There is always a large area of bark uninjured, permitting the tree to secure the steady nourishment required for its continued growth and the renewal of the latex supply, and four years, at least, during which growth is continuous, elapse before the old wounded areas are again approached. This means everything for the tree, steady growth, better powers of disease resistance, and less liability to wound infection.

There is only one point in this method where controversy arises. There is some difference of opinion as to annual rate of growth. Mr. Petch, and others contend that the annual increase of four to five inches in the girth of the tree reckoned by Mr Patterson can refer only to exceptional trees, or to trees exceptionally well situated as to locality and soil. Even if this be conceded, it in no way vitiates the advantage of Mr Patterson's truly scientific and rational method of tapping. It is certain that these same trees that do not put on five inches of girth a year would be very much more handicapped by another method of tapping, and that the Patterson system gives trees more chance of attaining to the increase noted by Mr Sheridan Patterson where he has experimented. In the matter of keeping the numbers of cuts low, and in their objection to the use of the pricker Messrs Petch and Patterson are agreed, whilst every practical planter will support Mr Patterson in his plea for full manuring and clean cultivation. At the same time we want more and more detailed information published on all sorts of obscure points, and particularly, as " Proprietor " says in his letter appearing above, on the proper harvesting of latex in different districts and at different altitudes. Theory is excellent, but it must be supplemented by practical experience and experience has a way of varying according to locality and circumstance, —A. M. & J. F.]

MR. W. WICHERLEY ON THE VALUATION OF COCONUT ESTATES.

Marawila, Nov. 20th.

DEAR SIR,—In your issue of November, you have an extract from the *Financial Times* under the above heading and signed by Mr. Wicherley.

When Mr. Wicherley was here last year, he posed as an authority on Rubber, especially on Ceara Rubber. He made application to Government on behalf of an influential Company to buy a very large area of land in the Wanni. The Government pursued an indefensible dog-in-the-manger policy, and imposed conditions which no sensible man could possibly accept.

During the time of his visit, there were wild rumours that he had at his back capitalists of unlimited means, and that as a first instalment several coconut estates of well-known Sinhalese families in the Negombo and Chilaw districts were to be acquired and formed in a Company, and thereafter the trade in copra was to be cornered!

He went away and did not return, but amuses himself by occasionally writing about coconuts and a coming boom, in financial papers.

On the present occasion, he poses as an expert valuator. He nowhere in his letter indicates that he is writing about coconut estates in Ceylon. That can, however, be safely guessed.

It is a libel on native estate owners to say that their estates are "for the most part grossly neglected as regards cultivation and wastefully managed into the bargain." I believe I have visited and valued more "native-owned" estates than any other valuator, and I cannot subscribe to the above.

I will not take exception to his statement that a full bearing tree will yield 40 to 60 nuts per annum, but I will qualify it by adding " under favourable circumstances." Nor is he far wrong when he states that 4,000 to 5,000 nuts go to a ton of copra. The general experience, however, is, that a given weight of copra will yield two-thirds oil and one-third poonac.

In very few instances are the husks of coconut used for fibre making. In most instances they are used for packing drains, protecting supply plants or for burning in quantities between the trees. Some penny-wise-pounds-foolish people sell their husks. These people can have no idea of the wanton robbery of the soil the sale of husks involves.

Mr. Wicherley is quite correct when he states that " valuations of coconut estates based on the *per capita* value of each tree are fallacious and utterly worthless from an investor's point of view." Yes. From the investor's point of view only. No careful valuator and one with a sense of responsibility does this.

Mr. Wicherley states that " one of the recognised systems is to take a qualified expert's report on the property as a whole and then to dissect the certified 'counts' of nuts for each of the six picking periods over the previous four years, carefully noting the picking of the fifth period, as this should always give the largest proportion (20 to 25 per cent.) of the total " yield."

The above is very funny and excites the risibility of "experts," who will not call themselves "experts," unless they can both report on and value estates; they find no necessity to dissect or perform any other surgical operation on the figures of each picking, when they have the total of the six pickings. Besides, it is very wide of the mark to say that the fifth picking gives tho largest proportion of the total yield. Every coconut planter, of even very limited experience, knows that this is not the case.

It puzzles one to be told that "the safest plan is to take an average of 20-45 per tree and divide the total into thousands." What in tho name of commonsense does this mean? Multiply that amount by three, and in this manner we get approximately the net annual income from the estate. What is three? Is it three pounds? If so, we get the *gross* and not *net* annual income.

No careful valuator who has a care for his reputation, will value indiscriminately all coconut estates, especially those yielding "20-45 nuts" per tree per annum, at 12 years' purchase.

Mr. Wicherley's process of valuation is thus:—500 acres at 60 trees equal 30,000 trees, at 40 nuts per tree equal 1,200,000 nuts by 3 equal £3,600 at 12 years' purchase equal £45,200.

I will value the same estate, taking Rs. 20 as the equivalent of £1. Thus:—

500 acres at 60 trees equal 30,000 trees, at 40 nuts per tree equal 1,200,000 nuts at £3 or Rs. 60 per thousand equal ...	£3,600
Expenditure at £2 or Rs. 40 per acre...	£1,000
Net annual income ...	£2,600
£2,600 by 10 years' purchase ...	£26,000

To the investor, mine is a safer valuation.
—Truly yours,

B.

RUBBER IN THE CONGO.

The Government of the Congo are paying special attention to the growth of the plantation rubber industry, having planted 30,000 of the Hevea Braziliensis, and ordered seven areas in the Bangala and Equator districts to be brought under cultivation. Experiments with the Manihot Glaziovii have been conducted at twenty different Government posts, the plants numbering 185,000, while other species will also be dealt with as well as the 11,000,000 old rubber vines known to exist in the country.—*H. & C. Ml*, Nov. 17.

BANANA STUFFING.

A new banana recipe is savoury banana stuffing (for roast pork, goose, or duck, etc.).

Peel six to eight ripe bananas and chop rather coarsely. Season well with salt and pepper, and add half a breakfast oup of white breadcrumbs, a beaten egg, chopped parsley, and savoury herbs to taste. Mix the whole well, and stuff the meat or birds in the usual manner with this preparation. The delicate flavour of the bananas givos a delicious aroma to the birds when cooking.—*E. News*, Nov. 1.

CACAO MANURING EXPERIMENTS AT PERADENIYA.

AN ABLE AND EXHAUSTIVE REPORT.

The cacao manurial experiments have been one of the main features of the Experimental Station at Peradeniya since its inception in 1902. But although these experiments have now been in progress for nine years, no attempt has hitherto been made to give anything like a complete account of the information which may be drawn from them. We are, therefore, all the more beholden to Dr. R. H. Lock for his very able and interesting report—constituting the "Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon," for October, 1911,—on experiments in manuring old cacao at the Peradeniya, between 1903 and 1911. Not only are these the most elaborate manurial experiments ever carried out in a tropical country, but they are probably quite as thorough as any experiments carried out in any part of the world with a permanent crop. The deductions to be drawn from them should, therefore, arrest the attention of all who have to deal with permanent crops, as well as of all who are interested in tropical agriculture. Dr. Lock points out in the first instance that the conditions of experiment have been far from ideal. The plots—25 in number, each measuring one acre, except three, each of which is divided into two sections of half an acre each,—include a mixture of varieties irregularly planted; and a varying number of coconuts—in some cases over thirty in a single plot—have been allowed to stand among the cacao. The crop of cacao does not, however, seem to bear any direct relation to the number of coconut trees, for one of the best yielding plots of the former contains no less than thirty-three of the latter. It was Mr. Herbert Wright, who, in 1902, planned the experiments in consultation with Mr. Kelway Bamber. The irregularity of the plots was then fully realized by Mr. Wright who pointed out the desirability of establishing even plots of young cacao upon which more reliable tests could be carried out; but when the duty of scientific superintendence was assigned to Dr. Lock in 1908, it was considered advisable to allow the treatment of the plots to continue without alteration for two or three years or more, in order that such conclusions as could be drawn from them should rest upon more or less solid ground. So a new plot, 5 acres in extent, was established in 1908 from seed exclusively derived from a single tree of a good Forastero strain, and it is hoped that this plot will allow of the carrying out of experiments which will afford a more satisfactory test of the influence of different artificial manures upon the growth and yield of cacao. Before the beginning of the experiments described in Dr. Lock's report, the wholo estate, including the experimental plots, had been allowed to fall into a condition of neglect. In particular, Albizzia trees planted for shado had grown into a veritable forest, and their removal could only be accomplished at the cost of considerable damage to the cacao. In association with the excess of shade, disease was rampant. Cacao canker was

so prevalent that in May, 1902, when the systematic treatment was begun, over 90 per cent of the trees on the whole station were diseased. By vigorous measures this number had been reduced below 10 per cent on the experimental plots by the end of 1903. Nevertheless, throughout the experiments the loss of crop from this scourge represents a considerable item. The total crop from each plot from 1903 onward is recorded in a comprehensive table from which we quote as follows :—

TOTAL NUMBER OF PODS PRODUCED BY EACH PLOT FROM 1903-1911.

Plot.	Treatment.	1903.	1905-06.	1908-09.	1910-11.	Average. 1905-11.	Average calculated to Cwt.
1	Unmanured	9311	15459	16163	7402	11755	9·0
2	Unmanured	7087	13036	14758	7750	9026	7·4
3	Lime once	6223	11773	9061	6360	7341	5·7
4	Cattle manure	4563	10251	8888	5003	6478	5·0
5	Lime forked	3225	8762	6751	4387	5676	4·4
6	Lime Unforked	2523	9151	7145	5326	6330	4·9
7	Basic slag and ammonium sulphate	2777	10952	7531	5404	6836	5·3
8	Kainit	2685	8653	7239	5460	6245	4·8
9	Bone dust	2256	8274	8193	6666	7191	5·5
10	Unmanured	3662	10276	7952	6417	7392	5·7
94*a*	Potassium chloride	4232	14094	11614	6992	9189	7.1
94*b*	Potassium sulphate	4523	14688	9770	5770	8715	6·7
95*a*	Sodium nitrate	4230	12824	8398	4614	7090	5·5
95*b*	Ground-nut cake	4432	12628	8861	4544	7358	5·7
96*a*	Concentrated superphosphate	3408	12270	8952	4582	7391	5·7
96*b*	Precipitated phosphate	4330	9058	9380	5192	6895	5·3
98	Fish manure	887	5677	7966	7981	6959	5·4
99	Blood meal	668	6530	4969	4414	5285	4·1
100	Castor cake	1125	6718	9827	5292	6360	4·9
101	Basic slag and potassium sulphate	2155	6149	8735	5436	6091	4·7
107	Basic slag, castor cake, and potassium sulphate	—	10600	9057	6334	7833	6·0
108	Ground nut cake and potassium sulphate	—	9684	7744	6805	7307	5·6
109	Potassium nitrate	—	8890	4961	4340	5564	4·3
110	Basic slag	—	10956	5950	4542	6386	4·9
111	Ammonium sulphate	—	11268	9311	6930	8284	6·3
	Average	3622	10038	8668	5822	7198	5·5
	Average calculated to cwt.	2·8	7·7	6·7	4·5	5.5	—

The recovery of the cacao from its initial enfeebled condition was marked by an increase in the general crop, which rose to a maximum in the season 1905-06 in the case of practically all the plots ; but the crop of 1906-7 was comparatively poor. In 1904 dadaps were planted over the whole area at the rate of 300—400 to the acre. These should have been kept lopped, but were allowed to get out of hand and to become closely crowded in 1906. With this fact, says Dr. Lock, the comparatively poor crop of 1906-07 may perhaps be associated. During 1907 the greater number of the dadaps were cut down, leaving only 30-40 per acre for purposes of shade. The crop for 1908-09 was the second best on record. The same dadap trees have continued to stand up to the present date as a source of lofty and even shade. Dr. Lock gives a complete list of the manured plots with a description of the treatment which each one has received. The general method of application of all the fertilizers was to scatter the manure in a circle round each tree and fork it lightly into the soil. At the beginning of the experiments the diameter of the circle was from three to four feet, but this was gradually increased to six feet, at which point the various circles generally met, the average distance between the trees being approximately twelve feet. More recently the manures have been applied in straight lines between the trees. Speaking generally, the soils of these plots are distinctly favourable for the growth of cacao, their mechanical condition especially being excellent. Arranging the plots in order of average crop gathered for 1905-11, Dr. Lock shows as the first remarkable result that the unmanured plots 1 and 2 come out easily at the head of the series. There is no exact record of the treatment of these two plots prior to 1903. They are, however, situated adjacent to the cattle sheds, and it is understood that the plots received large quantities of dung in the form of a mulch. We have independent reasons for regarding surface mulching as a specially valuable treatment for cacao, and we know from the results of the Rothamsted experiments that the effect of dung may persist in the soil for an indeterminate number of years. Dr. Lock has, therefore, little reason for surprise at the position taken by these two plots; but, after a series of interesting comparisons, he comes to the conclusion that of all fertilizers continuously applied, the best result is obtained from those which contain phosphoric acid, especially when this constituent is combined with nitrogen in such a form as bone-dust or fish manure. He says we may even go so far as to express the opinion that either of these fertilizers will probably yield a profit when applied to old cacao. There is no direct evidence that the application of any other form of manure leads to a profit. With regard to the above, Dr. Lock asks : To what are we to attribute a result so entirely contradictory of those obtained in the West Indies ? We have no data; he says, from which to reply to this question, but it is evident that extreme caution must be used in attempting to apply the results of the experiments of this nature. It is hoped that future experiments with young cacao will lead to more definite conclusions. Beside canker fungus, squirrels are said to levy a considerable toll on the cacao crops at the Experimental Station. They eat holes in the ripe or nearly ripe pods and remove the contents. Tables are given showing an annual average destruction of 528 pods by squirrels and of 725 pods by canker fungus—which means a loss of nearly a hundredweight of cocoa beans. Dr. Lock winds up his report with an exhaustive summary and discussion in which he states that the differences of crop which can be attributed to the action of definite chemical constituents are extremely slight, and it seems clear that the continued application of most artificial manures to a

cacao soil like that of Peradeniya is a waste of money, under the conditions of this experiment. Disappointing as the manurial results may appear at first sight, they are by no means devoid of interest when considered in the light of general agricultural principles. Apart from the question of actual fertilizers, several important facts have come to light bearing on the general cultivation of cacao. As to the effect of treatment other than manurial, Dr. Lock says it is not impossible that judicious pruning might lead to a somewhat better result, but upon this point the experiments under discussion afford no evidence. The practice of forking the soil during dry weather is decidedly harmful, even when only carried out to the small extent involved in burying artificial manure of little bulk. Two factors probably contribute to cause the damage herein involved: (1) the actual physical injury to the surface-feeding roots of the cacao tree, and (2) the increased evaporation from the soil caused by the removal of the surface mulch of leaves which is always present on good cocoa land. This in turn doubtless leads to further damage to the exposed roots. There seems to be no doubt, therefore, that forking as an annually recurrent practice must be condemned. In the cultivation of cacao in Ceylon nothing is more important than the proper treatment of shade. If the shade is too heavy, the attacks of canker during wet weather are facilitated; whilst absence of shade encourages the visitations of *Helopeltis* during the drier months. The shade tree *par excellence* for cacao in Ceylon is the dadap, and any excess of leafy branches affords an invaluable mulch. Finally, Dr. Lock says, the result of the experiments at Peradeniya warns us to excercise the greatest possible caution in drawing deductions from the results of experiments in the manuring of permanent crops in the tropics. The greater part of Dr. Lock's report had been completed when the new edition of the late Mr J H Hart's book on cacao came into his hands for review, and it is stated that Mr Hart's experience of cacao cultivation in the West Indies agrees closely with the deductions drawn from actual experiments at Peradeniya. Hart considers that the application of strong manures to trees in good health and in average bearing would tend to encourage rank and sappy growth, which would be non-productive, and loss of crop would result, and also that to dig deeply about the roots of a surface-feeding plant for the purpose of applying manure would be absolutely absurd. In conclusion, we quote in full the following practical recommendations by Dr. Lock :—

Practical Recommendations.

A.—For Further Experiments at Peradeniya.

1. The application of the present series of manures should be brought to an end without exception. A differential result as between the different plots is then more likely to assert itself than if the manures are continued. The separate gathering of crop from the different plots should therefore still be carefully carried on.

2. Experiments in pruning should be begun. This may best be effected by dividing existing plots into two, and pruning one-half whilst the other remains unpruned.

3. Forking and the burying of leaves in trenches should be discontinued, and the surface mulch should be encouraged as much as possible. This does not apply to the burial of husks, which must be continued for sanitary reasons.

B.—For the Improvement of Estates in Poor Condition.

1. The most important step is to get a high shade of dadaps in sound condition. If there is difficulty in getting dadaps to grow, artificial manures can probably be applied to them with greater advantage than to the cacao itself. A small quantity of basic slag and sulphate of potash, in the proportion of two of the former to one of the latter, applied about three feet from the base of the young dadap, should afford considerable encouragement to its growth. If shade is too heavy, on the other hand, it should be thinned out the operation being performed at the end, and not at the beginning, of the dry weather. About thirty well-grown dadap trees per acre is generally sufficient, and even these should have some branches lopped at the beginning of the south-west monsoon in districts which get heavy rain at this season. The old dadaps should be cut out periodically, and their places taken by newly-grown cuttings; seven years is probably quite long enough for any dadap to stand.

2. Removal of excessive shade is the first step in the treatment of canker—the greatest scourge of cacao in Ceylon. Other important measures are collection, if possible weekly during the season of heavy crop, of all diseased pods, which should be deeply buried, and the excision of diseased bark. In this connection it may be pointed out that it is generally better to remove the whole of a cankered branch than to peel off the bark from three-quarters of its surface, as is often done. Spraying may also be resorted to.

3. If cattle manure is available it may be applied freely as a surface mulch. In the dry weather especially some form of surface mulch is very desirable. And since, if the cacao is in poor condition, its own leaves will not be sufficient for this purpose, they should be supplemented by any cut grass, jungle leaves, and "cheddy" that can be collected.

4. If artificials are to be applied, the best appear to be bone or fish manure, in combination with a potash salt if the soil is deficient in that constituent. These should not be dug in deeply, but applied on the surface, and the soil just scraped over them with as little disturbance of the cacao roots as possible. Dadaps, as previously stated, may be fed up with phosphatic and potassic manure in small quantities and their leaves applied as a mulch.

5. In places where the growth of cacao is poor no pruning is likely to be required beyond the removal of weak and cankered branches. The need for pruning is indicated by over-luxuriance in the growth of the trees which run to leaf instead of producing crop. It is difficult to lay down any definite rules for pruning, since this is a matter for practical study and experience, the

Manihot Glaziovii for normal tropical climates.
Manihot Dichotoma for rather dry regions.
Manihot Piauiensis for light sandy soil only in rather dry regions.

These three varieties are very suitable for elevations; especially Dichotoma and Piauiensis which have been successfully planted up to 5,500 feet.

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object being to get an even distribution of stout branches suitable for bearing fruit without excessive crowding.

The proper time for pruning would appear to be shortly before the chief flowering season, for the sap being thus directed into the flower buds may be expected to lead to a better setting of the crop.

We are afraid we have not done sufficient justice to Dr. Lock's report in the above summary. The report is so scientific and at the same time so practical that we would advise our planting friends to obtain a copy and "read, mark, learn and inwardly digest" it.

SENSITIVE PLANT.

The Chamber of Agriculture of New Caledonia is offering sensitive plant seeds *Mimosa pudica* to the agriculturists of that Island. Judging by the price (50 centavos per kilo) and the directions for insuring rapid germination of the seeds, it would seem that the matter is being taken up quite seriously by the said chamber. This is somewhat remarkable in face of the fact that in many, if not all, tropical countries this plant has become a weed and in some instances a serious pest, killing out the natural grasses and intertwining its spiny stems among the forage and thereby rendering it practically worthless. One good report of it in the Philippines has reached this Office, but the statement that this plant was much relished by cattle leads one to suspect that there must be considerable variation of individual preference among animals in regard to this plant—or else that some semi-spineless form has originated here.—*Philippine Agricultural Review* for October.

THE GRAPE-FRUIT FOR CEYLON.

Dec. 5th.

Dear Sir,—Can any one say if the grape-fruit has been grown at all in this Island, in low, medium or high elevations? I append an extract from a London weekly by last mail which should stir up the R. B. Gardens or Agricultural Society.—Yours truly,

A LOVER OF "GRAPE-FRUIT."

(*Extract referred to.*)

"I wonder if many of your readers are aware of the charm of the grape-fruit," writes a correspondent. "It makes a delightful beginning to lunch, and is delicious at breakfast. Just now they cost threepence each, and the heaviest should be selected, as these are always the juiciest. Divide the fruit in two across the grain with a sharp steel knife, and remove the little leathery heart. Next go round the edges, cutting and loosening the pulp; remove all the pips, empty the pulp on a plate full of fine sugar, mix it very well, put half of the pulp back in each skin, sprinkle with more sugar, and let stand for twenty-four hours. Serve half a grape-fruit to each person on a little plate; it is eaten with a small spoon. Another way which is usual in America is to mix the pulp with mayonnaise dressing, and to slip an oyster into each portion. I find, however, that our friends like the first recipe better."

YIELDS FROM YOUNG AND OLD RUBBER TREES.

Hitherto it has been impossible to give anything like an adequate survey of the yields likely to be obtained from Hevea trees under cultivation in the Middle East. Now, however, we have detailed information regarding results obtained during the last six years from trees ranging in age from 2¾ to 25 years of age, growing under very dissimilar conditions and tapped on systems remarkable for their variability in principles. We now possess records of yields from exceptionally young and old trees, from trees with a difference of twenty years in age, from individual estates, and lastly from the whole of the tapped trees in the peninsula during specified years.

Yields from Young Trees in Malaya.

The yields obtained during the last five years in Malaya have been largely responsible for stimulating interest, agriculturally and financially, in the rubber planting industry. There are now about a hundred London companies producing rubber in Malaya alone, and the yields obtained over large acreages as well as from notable trees have so far given every satisfaction.

The yield from very young trees is by no means insignificant. An experiment was made in Selangor during 1909 with 2,845 trees which were only 2¾ years old; these were tapped for two months and gave an average yield of 0·297 lb. per tree. Tapping for only eight months 2,843 trees, 3½ years old, gave 1·24 lb. per tree, and in nine months 6,426 trees 3¾ years old gave 1·06 lb. per tree.

Another record shows that 6,444 trees 4¾ years old gave, in two months, 0·178 lb. per tree, and 4,420 trees, 5¾ years old, for the same period yielded 0·248 lb. of rubber. In another field, 400 trees, 4¾ years old, tapped for six months gave 1·107 lb. per tree, and 4,674 trees 5¾ years old, during the same period returned an average of 0·961 lb. per tree.

A large number of trees, all 5¾ years old, were tapped during 1909 for two, four and six months, and yielded respectively 0·248, 0·503 and 0·997 lb. per tree, or an increase of approximately 50 per cent for each two months' tapping.

We have already pointed out that other advices from the East have been received which show that some trees 3½ to 4½ years old in the Straits Settlements and in Klang have given at the rate of nearly one lb. of rubber per annum per tree. The bark of these trees is relatively soft and does not compare favourably with the harder texture of that on trees which have taken a longer time to attain the tappable size.

Excellent results have been obtained on Malay estates by cutting a large V or Y at a foot to eighteen inches from the base of the tree, the V extending half round the tree; when the tree is large enough a second V is cut on the reverse side. By such a method the young trees can be tapped regularly—almost every alternate day—the rubber is extracted only from the thick part of the bark, and a high yield is obtained from the basal regions.

From old Trees

In marked contrast with the above are the unexpected high yields obtained, in twelve months, from individual trees on various properties. On Jugra estate we are informed that seven to nine year-old trees gave seven lb. per tree, and on Cicely eight-year-old trees gave 8 lb. The Federated Malay States Company possess over 2,900 9½-year-old trees which gave 24,000 lb. of rubber in one year, or an average per tree of 8·2 lb. Twelve-year-old trees on Linggi yielded 10·7 lb. in twelve months, Batu Unjor is reported to have secured 10·73 lb. per tree from 6,800 trees at the age of from 11 to 12 years. A yield of 28½ lb is also recorded from the 17-year-old trees growing near the churchyard at Parit Buntar. Similarly high yields, equal to one pound of rubber for each year's growth have been published from time to time, but it is extremely doubtful whether such yields can be relied upon annually. In several instances the trees have been growing under exceptionally favourable conditions, and many do not appear to have been tapped until they attained quite an advanced age.

Yields in Ceylon.

It is quite manifest from a comparison of the figures available in this office that, up to the present, Ceylon takes a second place compared with Malaya, in point of annual yield from young trees and from definite acreages of known age. It so happens that the yields from old trees in Ceylon are exceptionally high. It is nevertheless, clear that the soil or climatic conditions in Ceylon are less favourable, in the first few years, to the growth of Hevea brasiliensis. Whether the moist conditions in Malaya will prove to be as beneficial to old trees as the dry environment in Ceylon remains to be proved. It must be pointed out that, though the rubber in Ceylon may only have been produced at the rate of 150 lb. per acre, per annum, other products on the same land have returned good crops during the same period.

From Young Trees.

There are very few, if any, estates in Ceylon where the trees are sufficiently large to permit of tapping under four years of age. In this respect there is a striking difference with Malaya, where tapping is often started as soon as the trees are three years old. Purely as an experiment some two-year-old trees were tapped in Kalutara, but the yield therefrom was insignificant. In this district quite a number of trees, tapped when four years old, have given over 100 lb per acre in the first twelve months. A yield of ½ lb. per tree is recorded from 2,119 trees, four years old, on the estate, and of 0·63 lb. per tree from 747 trees at the same age on Mahawale. On Rayigam 6,000 trees, four to five years old, gave ½ lb of rubber each, and a further 1,500 yielded 0·41 lb, each. Light tapping of young trees on a well-known Kalutara property gave 1·72 lb. of rubber per tree.

From Old Trees.

At one time a yield of two to three lb. per tree from eight to eleven-year-old trees on Kepitigala estate was considered good. One tree on Elpitiya, 46 inch in circumference and eleven-

years-old, gave 16 lb. of rubber when tapped on the spiral system. The Elpitiya tree had a circumference of 46 inches; the tapping was commenced in October, 1904; the tree was rested in November, tapped again in December, rested in January, 1905, and continuously tapped from February to June, 1905. Tapping was recommenced in September, 1905. The tree appeared quite healthy in April, 1908.

Individual trees of unknown age (probably 20 to 25 years) on Culloden estate, gave 10, 18, 23, and 25 lb. of rubber in twelve months, tapped on various systems. These trees gave an average of 18 lb. per tree, per annum, for four years.

Several trees at Peradeniya, when 29 years old, gave 6¾ lb. each in eight months, and were still in good condition. Others on the same site gave three lb. each in twelve weeks.

Upon the Imboolpitiya estate, in the Ambagamuwa district, at an elevation of 2,000 feet, several 28-year-old trees were tapped from 18th December, 1905, to 18th March, 1906, and therefore during three very dry months. One tree tapped seventeen times gave 3 lb. 7 oz. of dry rubber, two others, tapped twenty-one times, gave 11 lb. 7 oz.

The largest yield appears to have been obtained from the old Heneratgoda trees during 1909 and 1910. During that period the largest tree gave 160 lb. or at the rate of 80 lb. per annum. This, from a tree planted in 1876, gives one some idea of what yield can be obtained from Hevea on very poor soil at thirty-five years of age. It is only fair to add that the trees at Heneratgoda have never been systematically tapped and were not until a few years ago even experimentally operated upon.—*India Rubber Journal,* Nov. 11.

WATTEGAMA AND RANGALA REVISITED.

THE CHANGE IN 40 YEARS!

A flying visit from Kandy, made by our "Senior" to these North-Eastern planting districts recently, was chiefly interesting, for the great changes which have occurred during the past two, three and still more in four decades of years. Some of these were noted in the great extension of cultivation, the number of varied products now in evidence, and the increased number of villages and the population along the sides of each cart road. The ride on horseback from Kandy to Kelebokka was once described to us by Mr. M. H. Thomas, before there existed any cart-road whatsoever, to Panvila or beyond, and nothing North of the Mahaweliganga save the one military route to Matale; and the late Mr. Tytler, senior, had frequently to make his journeys between Dumbara and Pitakande or Hoolankande in the "forties," on foot or on horseback, in danger of floods, robbers or rioters! Our earliest visit to Matale, Kelebokka, Panvila and Rangala and Medamahanuwara was in 1864 when coffee—the only staple—was in its pristine vigour and at this time district and branch roads were just coming into evidence. How strange, however, that during the 47 years since, the connection (of 3 or 4 miles?) between the cart road to the Knuckles and the local road to Rangala has never been undertaken! No doubt it is a difficult trace; but how much inconvenience and trouble such a junction would have saved, and would have aided development, especially of village life and industries. There is scarcely a mile of road in the Kandyan districts which does not serve to support a series of native huts, boutiques or bazaars—a village in fact, which was never heard of in pre-planting days. But that is also true of our main line of railway, although only 44 years old, and is gradually becoming true of each succeeding line or extension, except on the Northern line. What a change would be effected if a prosperous populous village existed every 2 or 3 miles between Anuradhapura and Jaffna, alongside the railway or road. Meantime, what a picture of prolific varied vegetation is afforded North of and all round Kandy, and on to Matale, on to Kelebokka and to Teldeniya as well as through the Dumbara valley! Can anything in the tropical world equal these districts in native crops, in varied indigenous fruit shrubs or trees and in introduced products in cacao, rubber, coconuts, arecas, breadfruit trees, &c., &c. Rubber has come to reinforce cacao in the Wattegama and Matale valleys and "Para," as well as "Ceara," is now found to flourish in growth, and harvesting of latex, up to 2,000 feet above sea-level. Around Panvila there are several illustrations, and we had a bird's-eye view of one promising rubber plantation (Giddawa) in a new division close to the Hooluganga. But the most interesting and instructive part of our "flying trip" was along the Teldeniya road (traversed last 47 years ago!) and thence up the Rangala road (never passed over before, though most of the estates were visited by other routes) as far as to far-famed Duckwari. "Far-famed," because the name embodies four different plantations well-known by their names in the "coffee" days. Mr. Duckworth's Battegalla valley especially, was regarded as one of the richest deposits of soil (for "cherries") in the island. What wonderful crops (up to a ton an acre) did not poor "Jock Milne" pick from the coffee bushes there, and how the Messrs. Young on Rangala and Andrew Nicol, Martin, Anderson, Wright, Rose, Rudd, Esdaile, Fielder, Munton, Edwards, &c worked hard there for many years, planting, cultivating and reaping; but now there is not a single coffee bush in all the district; but instead, there is tea *galore,* of fine jât, vigorous and luxuriant. In addition to 800 acres of tea, the "Duckwari" Company has 270 acres of rubber and nearly as much of cardamoms and so, the experienced Manager (nine years in charge) and his two Assistants have no want of variety in their products or work. It added to our personal interest to find that in the Manager, and hospitable host, we had a grandson (the only one in the island) of the original "George Bird," the man who planted the first Ceylon coffee estate in 1824 and who, therefore, must have been the very first "planter" ever heard of in the Central Pro-

vince of Ceylon. [There ought to be a good portrait of this most persevering planter, excellent man, and interesting historic personage, in the Hall of the Planters' Association, Kandy.] To turn to practical items of the day, the new Duckwari Factory is well on towards completion. It will be remembered that the old Factory (a converted coffee store) was accidentally destroyed by fire, recently; and now its successor is to be a credit to its designers and builders, and a great advantage to all interested in its working and the products prepared in it for shipment. It was a disappointment to us to have no time on this occasion to run over the adjacent estates and get a proper idea of the Rangala district as a whole, and some notion of Nitre Cave and revive associations with old Medamahanuwara. Better luck next time! The run back to Teldeniya, and up to the turn of the road into and through Dumbara (with reminiscent thoughts of such friends—nearly all deceased—as Tytler, Souttar, "Ned" Mortimer, John Brown, Blacklaw, Watson, Greig, Vollar and Forsyth) the crossing of that fertile valley, the passage of the new iron bridge over the Mahaweliganga, and then on up to Kandy, was very enjoyable, and crowned a notable day for us in not the least important of the Northern Planting Districts.

CULTIVATION OF IPECACUANHA IN INDIA.

Attractive for many years to British experimentalists in plant cultivation for materia medica has been the idea of growing ipecacuanha in British India, and just now, when for two years we have seen the root from South America fetching high prices on the London market, users have naturally enquired whether our great Eastern Empire could not afford us some relief. As a matter of fact, the efforts of the scientific cultivator have been directed to this question for many years, but we fear, with but moderate success. The late Dr. Anderson, superintendent of the Royal Botanic Gardens, near Calcutta, first conceived the possibility of growing ipecac. for commercial purposes in India. Dr. King brought the first plants to Calcutta in 1866, but despite every care they did not flourish. Plants sent to the Rungbi plantations, near Darjeeling, did better, and by 1873 there were several thousand young plants in Sikkim and district. Somewhere about this time the Bombay Government sought consignment of the plants for cultivation at the cinchona plantations at Mahabaleshwar. The earlier work was confined to getting a large stock of plants for experimenting purposes, and a stimulus was given to the cultivation by the discovery that the plants, unlike most others, can be propagated freely by root cuttings. The plant requires a thoroughly tropical climate—that is, a fairly equal day and night temperature. In the Government teak plantations at Nilambur, in the Madras Presidency, some measure of success was early obtained. The position in 1902, as defined by Sir George Watt in a special handbook, seem to have been that, with the exception of the locality in South India mentioned above, no other district had been shown to afford the hope that it can become an important commercial producer. There were, he added, doubtless many other similar regions where it might be grown. The plant grows slowly, and has little in it to attract the attention of the cultivator, so that it may be doubted when private effort may be expected to relieve the Government of its present endeavours. Lately reported as in transit for the London market were a few bales described as from the Bengal Government's cinchona plantations, and Mr David Hooper, writing to us in this connection, suggests that the sort referred to must be Johore, but adding the following information as to the general status of Indian ipecacuanha as a commercial commodity:—

"I have recently been to the Bengal Government cinchona plantations in the Darjeeling district, and saw the ipecacuanha growing there. It thrives well under a light shade below the gardens at an altitude of 1,500 ft. There are about four or five thousand plants looking in good condition; they belong to the original stock introduced some years ago. At the Mungpir nurseries (3,800 ft.) there are several hundreds of cuttings ready for distribution; none of the roots, however, have been collected and sent to the London market. In the Madras Government cinchona plantations ipecacuanha has been grown experimentally at various elevations for a long time, but I have seen no notice in the annual reports of the drug being collected commercially. I think the root you refer to must be from Johore. I wish it could be grown on a large scale in British India."

It is, however, a fact that from time to time plantations of ipecac. in India have been uprooted and the produce sold in England. Still the conclusion on the whole seems to be that Indian ipecacuanha is till in an experimental stage, and, moreover, when it emerges therefrom if ever, it will remain for proof whether the medicinal properties are preserved in the Indian cultivated stock.—*B. & C. Druggist*, Nov. 10.

THE CONDITIONS BEST SUITED TO EUCALYPTUS TREES.

The native home of the valuable eucalypts is in the warmer portion of Australia and a few of the adjoining islands. The question of hardiness to frost is of paramount importance to the growing of Eucalyptus in the continental United States, because the range of the tree is there determined by its ability to cold. In Hawaii, however, the question of frost hardiness is not of great consequence because, outside of the summits of the three highest mountains in the islands, the temperature everywhere in the territory is sufficiently high for the growing of Eucalyptus.

Several species of eucalypts have been planted within the last three years on the west slope of Haleakala, on the island of Maui, at an elevation of between 6,000 and 6,500 feet, and a number of them are doing very well, notably the peppermint gum (*E. amygdalina*), the blue gum (*E. globulus*), the mountain ash (*E. siberiana*) and the broad-leaved iron-bark (*E. siderophoia*). Here the temperature is almost never lower

than 35°F. How much higher than 6,500 feet these trees would grow it is difficult to state, but there is no reason to believe that the temperature would be too low for a proper growth of the eucalypts at elevations as high as 7,000 or 8,500 feet, since the thermometer rarely drops below 32°F.

The temperature and moisture conditions most favourable to the growth of Eucalyptus in Hawii are an abundant rainfall, say between 50 and 100 inches per year, and a rainy season alternating with plenty of strong, warm, sunshine. Prolonged rain suddenly followed by intense sunshine and heat is injurious, especially to seedlings,

The eucalypts are intolerant of shade, and require plenty of light for their proper development. When given too much light, however, the eucalypts will branch out immoderately and will then not be of much value as a timber tree. The trees in their seedling stage can endure more shade than the older trees, and the very young seedlings require a certain amount of shade for their growth. When all are planted at the same time, the eucalypts can grow in dense stands and the trees will then form straight, cylindrical trunks. They will not grow, however, planted in the shade of other trees.

Most of the eucalypts have well developed root systems, and as a rule are not easily thrown down by ordinary winds, and a few species can therefore thrive in windy situations. The trees seem to suffer more by constant than by unusually strong winds, and the ordinary trade wind in an exposed situation will be more harmful than an occasional kona storm. The foliage of blue gum (*E. globutus*) and of red gum (*E. rostrata*) is particularly sensitive to strong winds. Sugar gum (*E. corynocalyx*) and peppermint gum (*amygdalina*) can stand much wind, though the trees will often lean to leeward and are then unfit for straight timber. The swamp mahogany (*E. robusta*) is generally considered sensitive to strong winds in California, but in Hawaii it is found to grow straight and of good form even in the most exposed situations.

The eucalypts, as a rule, prefer a very moist soil and respond readily to irrigation in dry situations. Swampy land, however, is not favourable to good growth, especially if the roots of the trees are constantly flooded. The red gum (*E. rostrata*) is probably the least exacting in the respect, and will thrive in wet swamps. Swamp mahogany (*E. robusta*), blue gum (*E. globulus*), and the bastard mahogany (*E. botryoides*) will also endure excessive moisture. The sugar gum (*E. corynocalyx*), on the other hand, is the most intolerant in this respect.

Unlike agricultural crops, trees are not fastidious as to the quality of the soil on which they grow. There is hardly a soil so poor as not to be able to support some tree growth. The chemical composition of the soil is of little importance, provided its physical composition is favourable. The physical composition of the soil is important because it determines to a large extent the amount of available soil moisture. A deep, loose, moderately fine-grained, sandy loam, is the best for most species of eucalypts, as it is for almost all other forest trees.—*West Indies Agricutural News*, Oct. 14.

THE CULTIVATION OF THE NUTMEG.

During the earliest period in the history of its commerce, the nutmeg, a native of the wilds of the Moluccas, pandered for years to the greed of the Dutch. For, perceiving the fact that in the world, as then known, it grew only in the evergreen forests of the "Spice Islands," not only was its cultivation prohibited by them but quantities of the nuts were actually burnt to keep up prices when they declined. Thus, for years, the outside world was held in the veriest bondage of trade by the Dutch—the most intrepid and venturesome maritime nation and the greatest fetchers and carriers of the time. Nemesis, however, overtook them in the shape of the great blue wild pigeon which, swallowing the nut in its red aril, digested the mace and cast the seed on land and sea beyond its home. This interesting fact in the distribution of the nutmeg coming, in time, to be generally known, its cultivation was, in spite of the Dutch, introduced into all or most of the countries lying about the balmy spice groves. Thence it entered the gardens of the Straits and through them has spread both far and wide,—in fact, throughout the tropics of the world. But the most productive regions of its cultivation continue to be near its home; for, though plantations of it flourish in the West Indies its greatest yield is still in the East,—the Malay Peninsula, island of Ceylon, and the silt-laden banks of the rivers of the West Coast. In these it is that the nutmeg tree—that graceful fragrant child of the sun—piercing the umbrage of its associates with its pert and shapely pointed crown, bears, amidst its dark green foliage, its golden pear shaped fruits in abundance. Maturing in the seventh month from the fading of the flower, the fruit splits open into two fleshy halves and discloses the glossy black shell of the seed enclosed in a net of the scarlet mace. This seed or nut, whole or shelled, is the nutmeg which, for centuries past, has always met the demand of the world for a mild, engrossing, and wholesome spice. Of all the famous spices of the East, it is not only this but even more—its fine and essential aromatic oils, whilst being the least aggressively pungent are also the most agreeably flavoured and gratefully fragrant obtained from a spice.

The nutmeg is a dioecious tree, *i.e.*, the male flowers, which are distinct from the female, are borne on separate individuals. These cannot, as a rule, be distinguished from those that bear the female flowers until both male and female trees begin to blossom, in or about the seventh year from planting. The tree is in leaf throughout the year and delights to live in the midst of other shady evergreen trees like itself. For its successful cultivation, it demands shade, at least for the first five-years of its life, a climate with a rainfall of at least 60 inches, and a well drained rich alluvial loam or virgin forest land for soil. It also prefers a low lying situation and needs protection from strong and drying winds. Protection from wind is an essential factor for its successful

growth anywhere; for being a very shallow-rooted tree, it is easily blown down by the wind. Organic plant-food in the soil is, perhaps the next important factor; for without it in a readily available form the tree is thriftless and its yield poor. For these reasons it is, chiefly, that in the systematic cultivation of the nutmeg tree, the best results are always obtained by raising it on the banks of rivers or streams that had been erstwhile covered with virgin forest. In any other soil or situation the tree requires to be heavily manured, watered in the dry weather, and protected from wind. Its cultivation demands some care and attention though no special skill appears to be called for. It may be pursued in the following manner:—Select for seed large round fresh nutmegs from fruitful mature trees in full bearing rejecting those that rattle in the shell. Sow the seed, in the shell, about a foot and an inch below the surface, in prepared beds or boxes of good soil, in a cool and shady place. Keep the seed beds moist by frequent watering. When the seeds sprout, after a month or two, water the plants freely particularly in dry weather. On selecting the site for the plantation clear the land and pit it at about 25 or 30 feet apart keeping the pits open for a month or two. Just before planting mix the soil excavated with two parts of burnt earth and one of old cattle-manure. When the plants are 2 or 3 feet high and have from 3 to 4 verticles of branches transplant them in showery weather screening from wind and the heat of the sun. Water soon after the plants are put out and, thereafter if possible, every second day or at least once a week throughout the dry weather. Banana nurses between the plants give them the requisite shade and protection. Earth up all roots that break out through the surface, keep the soil below the crowns clean weeded, and plough, harrow, or otherwise keep the soil between both lands and nurses in a thoroughly perfect degree of tilth. The plants should be mulched with dry leaves in the hot weather. The nutmeg is remarkably free from the attacks of insect pests or fungi; but is occasionally subject to invasion by *Loranthus* (Indian Mistletoe) and allied green semi parasites. These parasites as well as all suckers from the stem should be carefully removed when they appear. For manuring, carefully loosen the soil lying immediately over the roots and spread the manure evenly upon it. Manure annually after the first fall of rain and until the plants are five years old with the manurial compost suggested above at the rate of three or four bushels per tree. After the fifth and up to the fifteenth year the proportion of the ingredients may with advantage be altered to equal quantities of both burnt earth and cowdung and the amount applied itself doubled or tripled, except in the case of the male trees which being left in the proportion of one to every ten female trees should be treated so as to be kept healthy and strong but not so vigorous as the female trees. After the fifteenth year the dung in the manure should be only about a month or two old and form double the quantity of the burnt earth. Other organic manures in place of cattle dung that may be used with much success are groundnut oil cake and vegetable mould. The nutmeg begins to bear in the sixth or seventh year, attains to full between the fifteenth and thirtieth years and continues to bear two or three crops a year annually up to the eightieth year when the yield begins to decline. Trees more than a hundred years old planted by the descendants of the Dutch in Cochin are still in good condition and bearing on the right bank of the Periyar in north Travancore. Again a small garden of nutmeg trees planted by Dr. Helfer at Kaupya in Mergui are still productive under the care of the Chinese Babas. About two-thirds the number of trees planted out will be generally female trees which bear on an average in the fifteenth year about 2,000 nuts each. Varying with size from 80 to 150 nuts weigh a pound, so that the yield per tree at the lower rate is about 13 pounds per annum. The yield of mace is usually about one-fifth the weight of the shelled nuts but its value is twice as much as the latter. The price of nutmegs in the London market varies from 6d to 1s per pound and of the mace from 1s to 2s per pound according to size and quality. The value of the annual yield of an acre holding only 30 bearing trees estimated on the lowest weights of produce and on the mean, in each case of the market rates would be about 18. This is the possible average annual return from an acre in the fifteenth year which is but the commencement of maturity but as the estate would be productive for at least seven years previous to maturity a considerable and increasing profits admit of being annually taken from and after the commencement of productivity.—*Capital.*

THE ECONOMIC VALUE OF TEA.

Thomas Martindale of Philadelphia, who has just returned from a hunting trip in the Maine woods, in a letter to the "Journal of Commerce" lauds the value of tea as a beverage. He says:

"Let us contrast the economy of the use of tea as against the present prevailing prices for coffee. The consumer can, or should, easily buy a pound of really good tea for 50c, and out of this 16 ounces of tea the consumer gets an average of 240 cups of good, strong tea, or about 1-5 of a cent per cup, whereas a pound of good coffee, costing say 30c, will only produce about 75 cups, or very much more than double the price of tea. As between the virtues of the two beverages I have over and over again tested them under the best conditions that a man can have, namely in the pursuit of big game where the hardest sort of walking, say up to the high mountain elevations, or down to the lowly bogs is necessary, day after day, in all conditions of weather, rain or snow or excessively low or equally excessive high temperatures prevail.

Under this crucial test tea will sustain a man's vigor and keep his spirits up much easier than coffee without leaving any bad after effects such as sleeplessness and indigestion.

The rank and file of the working people of Great Britain, Russia, Poland, Sweden, Norway, Denmark and in our own far Northern sections as well as in those of Canada have found this

tact out long ago. When the trapper is outfitting for the winter, next to his bacon, salt and flour always comes the pound or the two pounds of tea, Coffee indeed heing not thought of at all. The Hudson Bay Company in outfitting its trappers in the Far North load their dog sleds up with a liberal supply of white fish, which does equally as well for the dogs as the trapper. If wild geese have been killed in plenty during the previous fall, a few of those for the trapper only are strapped on the sled; then comes some salt, a little bacon, flour, matches, a few candles and surely the pound of tea. On my recent hunting trip of 38 days I took with me a canister containing 12 ounces of the top line of a chop of 'String' Foochow Oolong. My guide and I used from it morning and night, and also at times when we came to our cabin for dinner. It was always good, always cheering, always nourishing, and that 12 ounces lasted us for the whole trip and a little left. In England particularly the consumption of tea is always increasing. There when 'riches take wings and reputation falls to pieces' tea is the final comforter. An English writer eloquently extols 'tea as a soothing drink; the dissolvent of all unmannerly humors, the ally of all good grocers, the friend of the whole human race, the contemner of class, the comfort of the duchess and of the washwoman, the faithful companion in all ranks of life of every waking and many half-waking hours.' It is this homely impartiality of tea that makes the eulogist's task so easy." Mr. Martindale also looks for a higher range of prices on tea, as a result of the present rebellion in China and says: "In the meantime the man who sits down and waits for present values to shrink and go back to the former low levels will, like Rip Van Winkle, wake up some day and find that the world 'indeed to move' and that he has been left high and dry on a rocky shore without tea and minus his profits from not being on the band wagon rather than behind it."—*American Grocer.*

ROSELLE.

The roselle (*Hibiscus subdariffa*) which was introduced and distributed to a limited extent this spring by the Bureau, is making a most satisfactory growth at the experiment stations, and a good yield of fruit and seed for future distribution is expected.

The roselle is an annual related to the cotton and okra, and is probably the only plant in the world whose calyces are utilised for food. The plant flowers in October and the rapidly developing fleshy calyces are picked and used in making sauces, jellies, or jams, very similar in flavor to those made from the cranberry. A good wine is also made from the calyces. A very agreeable cooling drink may be made from the leaves and tender twigs, steeped in boiling water. In India the roselle is grown principally for its fibre.

The many useful qualities of the roselle and the ease with which it may be cultivated are sure to make it a favourite among all classes as soon as it becomes known in the Philippines.—*Philippine Agricultural Review* for October.

RICE, DRY GRAIN, COCONUTS, TOBACCO AND COTTON IN N. PROVINCE.

The paddy crop of the peninsula and Puneryn having failed in 1909 for want of rain, on which it is entirely dependent in the north-east monsoon, the population was feeling the pinch in 1910. Ploughing rains in 1910 were not altogether timely, but fields were sown, and the crop was almost on its last legs owing to drought when heavy rain fell and saved it. In December a period of drought set in, and for the second time the crop was in jeopardy, when on the last day of the year there was heavy rain, sufficient for the crop till harvest time. The harvest was medium to good, an improvement on several years past. In 1910-11 paddy has been between Rs.2 and Rs.2·50 per bushel; the price of the various kinds of dry grain has been normal. Coconuts have suffered greatly from the long periods of drought. Tobacco has been a good crop. This industry, on which the people depend for ready cash, was in great trouble during 1910 owing to the Indian Government putting up the duty on Jaffna tobacco exported to Travancore to a figure which stopped the trade. An adjustment was eventually arrived at, the old duty being re-established on condition that no more than the average quantity of the last five years should be exported from Jaffna. On this arrangement there is overproduction this year, and the necessity for other products to replace tobacco to some extent is apparent, but not easy to organise, as the Jaffnese are conservative in the extreme and lack power of co-operation Some tobacco traders are, however, making arrangements to secure a lease of a land near the town of Jaffna for experimental purposes, and encouragement has been given to this project by a visit of Mr. Van Leenhoft, a tobacco expert recently in Ceylon on Government account. Mr. Van Leenhoff examined the local conditions of this industry and will report to Government. Cotton is grown in the island of Delft, and there is some thriving in the Jaffna Jail. Para rubber is growing on Government land at Vavuniya; it is kept alive by irrigation.—*Mr. Freeman's Administration Report* for 1910.

PLANTING IN TRINIDAD.

Whilst clean-weeding in the East is almost a *sine qua non*, in Trinidad and Tobago the nearest approach to clean-weeding is that carried out on sugar estates, while in cacao plantations the weeds are merely kept back to some extent hy the practice of "brushing," that is, slashing them down with cutlasses, leaving the roots in the ground and scattering the seeds over the soil. According to a brochure recently issued hy the first-named Colony's Department of Agriculture, rubber planting there is in its infancy, and, owing to lack of confidence or the necessary technical knowledge in cultivation and extraction of latex, the progress has not been very rapid. There are at present in Trinidad some rubber trees of ages varying from one to fifteen years of the following species, and the following figures have been returned in answer to circulars from the Department:—

Hevea, 80,004; Castilloa, 600,000; Funtumia, 25,000. It is not possible to compare the growth of these trees with those of similar age in Eastern plantations because in the latter countries the trees have been grown from their being planted as stumps on clean-weeded land, and the height and girth under these conditions is much greater than in the case of trees surrounded by weeds or shading the soil with other trees and shrubs. The entire northern half of Tobago possesses soils and environments well adapted to rubber culture. Many estates have already entered upon the productive stage, and the yield per tree, as well as the quality of the product indicate that Tobago must be regarded as one of the most important, if not the most important, rubber producing island in the West Indies. An idea of the rapidity at which the Tobago rubber industry is growing may be gathered from the fact that in six years its export of rubber has risen from 91 lb. to 4,348 lb. The cultures are as yet young and only an insignificant area has been tapped. It is estimated that about 120,000 rubber trees are now under cultivation in that island. The constantly increasing demand for rubber has been so great that this article is now recognised as one of the staple agricultural products of the tropics. The colony of Trinidad and Tobago is singularly favoured both as to soil and climate, but has so long prospered on its two great staples, cacao and sugar, that scant attention has been given to other pursuits. Rubber was first planted in the colony by a few progressive proprietors of an experimental turn of mind. The ample rewards which came to them soon induced other planters to devote parts of their acreages to rubber culture. Year by year these have been extended by *bona fide* planters. The rubber industry of the colony is free from speculative features, and Trinidad and Tobago offer today one of the richest fields for the tropical agriculturist desirous to devote his capital and energy to the growing and remunerative rubber industry.—*F. Times*, Nov. 1.

SOYA BEAN CULTURE IN CEYLON.

The soya bean which has come into prominence recently, owing to its commercial value, has now been successfully experimented with in Ceylon. The Agricultural Society secured a large quantity of seed some time ago from the Far East, and experiments were carried out at the Botanic Gardens at Peradeniya, but the cultivation proved a failure. The Secretary of the Ceylon Agricultural Society has now succeeded, however, in turning out a large crop in the Government stock gardens in Colombo, producing two varieties, the Japan (white seed) and the Java (black seed), and seed will, it is said, be shortly available for distribution. It is expected that the cultivation of the soya bean will be taken up largely in Ceylon, for besides its value as an article of food it can be exported to the European and American markets.—*Royal Society of Arts Journal*, Nov. 17.

THE BANANA INDUSTRY OF SANTIAGO DE CUBA.

The production of bananas is second in importance among the agricultural industries of Santiago de Cuba. There are three districts where bananas are grown for export. Saetia, on Nipe Bay; Sagua de Tanamo, on Tanamo Bay, and in the region about Baracoa. The plantings at Saetia and Sagua de Tanamo are on lowland along the valleys of the Yumuri and Tanamo Rivers. The soil is a deep loam, formed from the deposits of the rivers and streams flowing from the Mayari mountains on the south and from decomposed vegetation. At Baracoa, tho plantings are in the valleys and on the mountain slopes. The soil is also a deep loam from a disintegration of the rocks and earlier vegetation. There has been a large decrease in banana growing for export during the last decade. Large areas devoted to that industry have been planted in sugar-cane because greater returns are derived from land planted with cane, and because the fruit produced in Cuba cannot compete with that of the Central American States, the winters of Cuba being too cold and dry. All the bananas produced for export are sent to the United States.—*Journal of the Roya Society of Arts*, Nov. 10.

RUBBER SUPPLIES.

It seems likely that the cultivation of Ceara rubber on the Upper Blue Nile will be carried on successfully, and that a good deal of wild rubber will be got from the Bahr-el-Ghazal province. The Imperial Institute furnished reports during 1910 to the Government of the Sudan on Landolphia and Ceara rubber on the basis of investigations conducted in the scientific and technical department, followed in some instances by submission of samples to manufacturers and experts for technical trial or valuation. The report gives details of two consignments. A small consignment of rubber from the Bahr-el-Ghazal, derived from the indigenous vine, was forwarded for examination and subsequent sale. The rubber was in the form of biscuits and sheet, varying from light to dark brown; it was of good quality and contained from 92·7 to 93·6 per cent. caoutchouc in the dry material. The consignment, weighing 647 lbs., was divided into four lots and sold in London at prices ranging from 6s. 9d. to 8s. 4d. per lb. Brokers reported that the rubber was exceptionally strong and that prepared with a little more care it should realise prices comparing favourably with those of Eastern plantation rubbers. A sample of Ceara rubber, derived from two-year-old trees at Mongalla, consisted of clean biscuits of pale yellow rubber which exhibited good physical properties. Great care had been used in the preparation. It was not quite as good in composition as specimens of Ceara rubber from Ceylon, but it was superior to several samples from East Africa which have undergone examination at the Imperial Institute.—*Journal of the Royal Society of Arts*, Nov. 10.

A BLEEDING RUBBER TREE.

A planter in Johore sent some time ago an account of a rubber tree which continued for a long time to exude latex without any apparent reason. Possibly other of our readers have come across similar instances.

The tree is, he says, a well grown tree, originally a seed planted at stake in October, 1908, growing on a very old grey clay flat on the edge of a drain. The girth of the tree on August 17 was 12 inches at three feet from the base, on three occasions I have dug out large lumps of rubber from the base of the tree. The first time was a year previously and the last at the date of his letter, when he obtained 2 pounds of rubber. The roots of the tree are quite healthy and the tree by no means top-heavy, the branches not too large for the tree to support and there is no reason to suppose that the tree has had a wrench from a high wind. The latex oozes from the point where the large roots proceed from the collar of the tree. The latex also gushes out at a point where one of the branches joins the main trunk and runs down the stem.

This bleeding has been going on for a whole year, and yet the crown of the tree looks perfectly healthy and has put out fine new shoots. There is not a dead branch on the tree nor an unhealthy looking leaf. He remarks that at the rate of rubber production in this way, it would be satisfactory to have a number of such trees as it only took him two minutes to dig out 2 pounds of wet rubber, and a cooly could collect 150 pounds a day at a cost of 50 cents, *i.e.*, a third of a cent a pound, and even cheaper on contract rates.

I have not seen the tree and can give no suggestion as to the cause in this case, but the amount of latex produced by so small a tree is rather remarkable, as it seems to be a good deal more than one could obtain from so small and young a tree by ordinary tapping.—ED.—*Agricultural Bulletin,* for Nov., 1911.

CHINESE POMELOS, OR GRAPE-FRUIT.

Various kinds of pomelos are grown extensively in southern China, all of which vary more or less widely from the American grape-fruit, although belonging to the same family. Those grown in Amoy are the largest, and are regarded by foreigners as the best produced in China. A smaller kind is grown in the Foochow district, many of which are shipped to Amoy, there given the Amoy "chop," and then returned to Foochow as imported Amoy pomelos. The object of this, of course, is to give an inferior fruit the benefit of the Amoy reputetion. The Amoy pomelos compare favourably with the American fruit in point of size, are thick-skinned, comparatively juicy, but decidedly bitter. The Chinese themselves prefer the Kwangsi pomelo, which is smaller but sweeter. —*Royal Society of Arts Journal,* Nov. 3. [The Agricultural Society should try and get seed.— A. M. & J. F.]

RUBBER IN ANGOLA.

For the following valuable notes on Angola I am indebted to Mr. E H Heron, for several years on the staff of the Department of Agriculture in the Mozambique Province of Portuguese East Africa. Having resigned his engagement Mr. Heron (who is an Australian and a graduate of the Hawkesbury Agricultural College, New South Wales) was travelling to England on the Grantully Castle, and was invited by Mr Robert Williams to accompany his party on the trip up the railway from Lobito Bay: "All the rubber at present obtained in this part of Angola is collected by the natives from the root of Landolphia Kirkii. This rubbor, if collected properly, is always valuable; clean consignments in London realise only 1s. 6d. per lb, less than the best Para. With regard to plantation rubber, two varieties of Manihot have been grown by Dr. Bravo with good success. He has already tapped some of these two-year-old trees (standing 10ft. high), and obtained as much as $1\frac{1}{2}$oz. each tapping.

"Manihot rubber grows well at an altitude of from 850 to 1,200 metres; the soil of Angola is also well adapted to it, being very friable, loose, containing no clay and not too rich. The rainfall is apparently ample.—London *Times,* Nov. 28.

BLASTING TREE STUMPS.

At Studley Horticultural and Agricultural College yesterday some interesting experiments in the blasting of tree stumps were conducted by Mr W Wheatcroft on behalf of Nobel's Explosive Company. The method adopted was to bore several holes, about 3ft. deep, into the stumps. Into these dynamite cartridges were put and they were exploded by electric current, the stump being blown out of the ground. Experiments in blowing up trees were also carried out; in that case the charge was laid at the roots. Altogether about forty tree stumps and three standing trees were removed. An important element is the saving in expense. Under the old method of removing roots the cost in some cases was equal to the value of the timber. Under the new method it is estimated that each root will cost not more than 2s.—*M. Pos,* Nov. 18.

DESTRUCTION OF LANTANA.

The Chamber of Commerce of New Caledonia has just sent an expert to Hawaii to collect and take back a quantity of the flies which have been found to greatly assist in keeping that terrible weed in check there.

This shrub which caused so much damage in Hawaii a few years ago is now generally scattered throughout the Philippines and is spreading, not rapidly perhaps, but surely, unless more active measures are taken to eradicate it. So far as we know the only efforts made to destroy this plant on a large scale have been made at and near La Carlota experiment station, Occidental Negros.—*Philippine Agricultural Review* for October.

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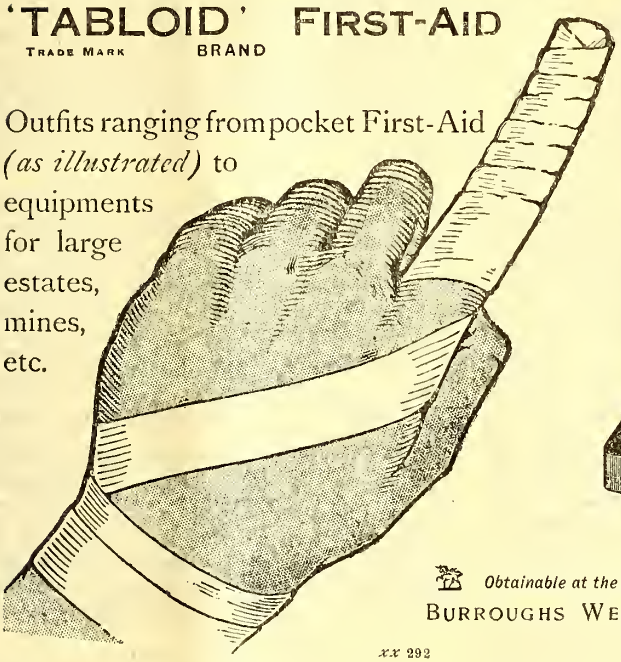

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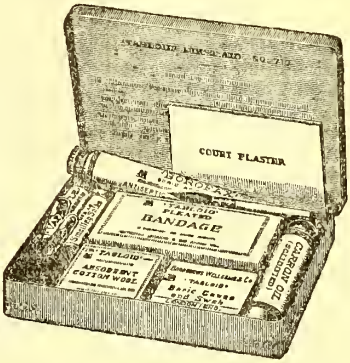

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OCTOBER 1911.

CAMPHOR OIL.

Very little that is new has happened in the camphor oil market during ths last few months. As before, the United States have continued to be the principal buyers, and have occasionally been willing to pay prices for which there was really no justification in view of the marked quietness of the camphor market and the falling tendency of turpentine oil. For the moment scarcely any camphor oil is offering but in spite of this fact prices have not become materially firmer. Both in Europe and in the U.S. large supplies of crude oil are available, and the existence of these affords some security that for some time to come no surprises are to be feared. Moreover, as stated above, there has been a not inconsiderable reduction in the prices of turpentine oil. Hence it is hardly likely that from this quarter there will be any inducement for an advance of camphor oil, which most frequently serves as a substance for turpentine oil. In spite of this reduction, however, the demand for the various grades of light and heavy camphor oil has continued to be extremely brisk at unchanged prices, which clearly proves that these oils have everywhere become indispensable; that as compared with the numerous other turpentine oil substitutes, their employment offers certain advantages; and finally that in certain cases camphor oil is to be preferred even to turpentine oil.

According to a report from the British Consul at Tamsui, which has just been published, the energetic action by the Japanese Government against the savages in the interior of Formosa has had the result of opening up in the north of the island an extensive forest district, rich in camphor trees. Several important native tribes were overthrown at the end of 1910 or have voluntarily surrendered, so that in the course of the present year a new and important region has been made available for Japanese civilisation. The quality of the camphor trees is said to vary considerably in the different districts. The camphor oil which is prepared from the trees in the north are decidedly richer in camphor than those prepared from the trees in the south, — hence the opening-up of the northern forests is of special importance. The Japanese Government continues to support the planting of new camphor trees by placing trees from the Government schools of Forestry at the disposal of the planters. The distillation of camphor oil from the leaves is still in the experimental stage. As in previous years, the entire production of camphor oil in Formosa was sent to Japan in 1910 to be worked up for camphor.

According to the same source, the exports of camphor from Formosa in the year 1910 were as follows :—

		lb.
United States	...	2,942,800
Germany	...	1,808,000
France	...	908,667
United Kingdom	...	542,400
India	...	249,333
Japan	...	35,072
Total	...	6,486,272 lb. (Value £404,112.)

It is further reported that last year the Japanese camphor refiners had to pay 5 yen 80 sen (= 11/10½d.) per 100 kin (133 lb.) more for their crude camphor than was paid by their competitors in Europe and America, and that in consequence they started an energetic movement for the purpose of inducing their Government to sell crude camphor within the Japanese Empire at the same price as abroad. It was pointed out that the cost-price of camphor was of great importance in view of the fact that the manufacture of celluloid has recently been started in Japan, and that camphor is the principal raw material for this manufacture. In the meantime the Government of Formosa has ordered the price of camphor for shipment to Europe to be raised, as from April 1st, 1911, from £5 5s. to £7 10s. per case.

A chapter in the *Yearbook of the U.S. Department of Agriculture*, by S. C. Hood and R. H. True, contains particulars of the present position of camphor cultivation in the United States, of which an American periodical publishes an extract, dealing principally with the yields which have been obtained thus far and with the prospects of the future development of the plantations. It is stated that an examination of 1,000 trees in the Statesof Florida, Alabama, Louisiana, Texas, and California revealed considerable variations in the yield of camphor from leaves and from branches. For instance, a few trees which had grown up in the shade of other trees or of high buildings only yielded 0·70 per cent. of crude distillate, whereas other trees, which had grown on poor soil and had received no care, yielded up to 2·77 per cent. distillate. These figures, however, represent the extremes on either side ; as a general rule a yield of from 1·75 to 2·25 per cent. may be expected, calculated on green material. The crude oil contains from 75 to 80 per cent. pure camphor, which thus equals an output of from 1·35 to 1·50 per cent calculated on green material. This yield may be increased by trimming the trees, and especially by growing them in hedges. To such an extent is it possible to increase this yield, that the output obtained up to the present from hedge rows grown at distances of 15 feet (space between the separate trees 6 feet, height of the trees 8 feet), amounted for each of the two trimmings which were made yearly to 8,000 lb. of green material per acre, corresponding to a total yield of pure camphor of from 175 to 200 lb. yearly. The planting of camphor trees is specially recommended on light, sandy soil, such as is found in many parts of the Southern States, especially in Florida. At the same time it is desirable, in view of the high cost of transport, to erect a distillery, and if possible also a refinery, in immediate vicinity to the plantation. In order to keep such a plant going rationally a plantation of at least 200 acres is required. The cost of production calculated per pound is of course less when operations are conducted on a large scale, and it may be assumed that a plantation of 500 acres would be sufficient to warrant the production of camphor at the lowest possible price.

D. E. Hutchins, lately Conservator of Forests, communicates some interesting information on the natural occurrence of camphor-trees in German East Africa. According to this authority, the camphor-tree is abundant and shows a good natural production in a forest situated in the neighbourhood of Wilhelmstal and leased by a Mr Wiese. At one place in the West Usambara Mountains, for example, Hutchins counted 26 seedlings of camphor on 20 square yards. Their appearance, he states, was more vigorous than that of the suckers which constitute 99 per cent of the reproduction in British East Africa. Unfortunately, Hutchins omits to state whether the tree is botanically allied to the true camphor-tree (*Cinnamomum Camphora*). Hutchins regards it as curious that neither the botanical staff at the Imperial German Biological-Agricultural Institute at Amani nor the forest officials at Wilhemstal had recognised the tree.

SYNTHETIC CAMPHOR.

The Journal from which we take the above particulars points out that, some years ago, Hutchins, on behalf of the British Colonial Office, investigated the potentialities of the forests of Kenia, British East Africa, and on that occasion reported on the occurrence there of the "Ibean camphor-tree"* but that nothing appears to have been done since then to confirm the camphor-bearing properties of that tree.

As a result of the fall in price of natural camphor which took place some time ago, the manufacture of the synthetic article of course received a heavy blow. An editorial article in a French journal states† that a(French?) company which controls several processes relating to the manufacture of camphor has circularised its shareholders to the effect that the cost of production of synthetic camphor must be kept as low as possible, and that with the prices now ruling for the raw material, turpentine oil, it is impossible to make the manufacture pay. The company, however, was in possession of a new process for the preparation of a cheap turpentine oil, for the carrying-out of which it was intended to float a subsidiary company. The writer of the editorial comment asks how it would be possible by such means to bring about a considerable reduction in the cost-price of synthetic camphor without causing first of all a general reduction in the price of turpentine oil as a result of the working of the new process and he enquires whether, for this reason, it would not be more remunerative to sell the

* Comp. Report October 1907, 26.

† Journ. d'Agriculture tropicale 11 (1911), 156

new cheap turpentine oil as such, instead of using it to prepare artificial camphor.

CINNAMON OIL, CEYLON (G. Ph. V).

Within the past few months cinnamon chips have continued to show only slight fluctuations, and quite recently it was even possible to buy at somewhat reduced rates. The prices of our pure distillate have remained unaltered.

CITRONELLA OIL.

Quotations of Ceylon citronolla oil (Schimmel's test) had for a long time been in the neighbourhood of 10d. cif., but within the last few months a firmer tendency has gradually become perceptible, and under its influence the quotations finally advanced to 1s. up to 1s. 2d. cif. European ports. This tightening of the prices is somewhat difficult to understand, especially in view of the fact that as a rule July and August are the very months in which the largest arrivals come forward in Ceylon and also because in our opinion the demand both in Europe and in America has not improved, but on the contrary, has, if anything, fallen off. It is possible that the parties interested believe themselves justified in raising their quotations on account of the not inconsiderable decrease in the exports during the first 7 months of the present year, for the latest available figures relating to the citronella exports from Ceylon are as follows:

From January 1st to August 21st 1911 915,683lb.
In the corresponding period of 1910 1,070,732,,
,, ,, ,, ,, ,, 1909 1,106,731,,

The above figures show that the deficiency of the present year's exports compared with those of 1910, to which attention was already drawn in our April Report, has not, as might have been expected, been equalized. The sluggish state of trade which has prevailed in this article in recent months should have been sufficient to show that there could be no question of any increase in the demand, and the raising of the prices could therefore at best be due to artificial manœuvring, unless indeed the higher requirements as to quality which have been set up within the past few months have caused the native dealers to raise their ideas of the value. However this may be, we are inclined to think that the present firm tendency will not be of long duration, and that if prices should nevertheless rise still higher, the large soap-makers, who are the principal consumers, will find it easy to turn to other articles which, after all, are not more expensive than citronella oil.

The pure estate oil with a geraniol-content of 57 to 62 per cent, which was introduced by us in the spring of the present year, has already secured a number of regular buyers, but generally speaking this exquisite quality is not by far esteemed as it deserves to be. To our regret we have observed that, curiously enough, the very firms of soap-makers, especially in England, who formerly were always the first to insist upon certain standards of quality, and who were in the habit of referring to the insufficiency of "Schimmel's test," are now, when we have succeeded in procuring at a low rate an oil which answers their requirements, taking little or no notice of this new quality.

Java citronella oil has continued to be available in such ample quantities that we have even been enabled somewhat to reduce our prices.

A method for the acetylation of citronella which originally appeared in the *Chemist and Druggist*, and which has recently been reprinted in an American contemporary), has inspired a searching criticism by C Kleber. First of all Kleber corrects the assertion which is made in the description of this method that the acetate of sodium is added for the purpose of absorbing the water formed in the course of esterification with acetic anhydride. As a matter of fact, the sodium acetate merely plays the part of a catalyser, for since no water whatever is formed in the course of the reaction, none can be absorbed. Moreover, every trace of water which might be present would be absorbed, not by the sodium acetate, but by the acetic anhydride, with generation of a corresponding quantity of acetic acid; hence, in order to obviate errors, Kleber expressly recommends the use of *fused* instead of dry sodium acetate, on the ground that the ordinary crystalline salt, although it looks dry, in fact contains 3 molecules of water of crystallisation, which would effect the decomposition of a portion of the acetic anhydride.

Further, according to Kleber it is impracticable to wash out the acetylated product with water, because too many washings would be required to remove the acid completely. The object is much more quickly attained, he states, by shaking once with a solution of common salt, running off the aqueous solution, and completing the neutralising process with a 10 per cent. carbonate of soda solution, which should be added in small portions, the mixture being vigorously shaken each time. The completion of the reaction is indicated by the cessation of pressure in the separating funnel after shaking 4).

When the oil has been acetylated and washed out it must not be dried with anhydrous sodium bisulphate, as laid down in the *Chemist and Druggist*, but with anhydrous sodium sulphate, because the first-named agent, owing to its acid properties, might split up the geranyl esters. Warming on the water-bath also is not only superfluous but positively objectionable. Half-an-hour is not enough to saponify the ester which is formed; the oil should be left upon the water-bath at least one hour, two hours is still better.

Kleber next refers briefly to the geraniol-test, the general introduction of which for commercial purposes would scarcely, in his opinion, afford the universal panacea against adulterations which it is claimed to be by others. Kleber specially holds this view because the practised sophisticator would find ways and means of imparting to his oil the required acetylation-value by means of esters, alcohols (fusel oil, &c.) and acids, and because the "average pharmacist," judging blindly by the acetylation value, would fail to detect such additions.

Another English periodical now enters the field with proposals relating to the tests which Ceylon citronella oil should be required to meet. It demands that the constants of the oil shall be as follows :—

D 15° 0·898 to 0·910,

αD—7 to — 13°,

acid content (calc. as acetic acid) not to exceed 0·25 per cent.,

acetylisable constituents (calc. as geraniol) not less than 58 per cent. soluble in 2 or 3 vols. 80 per cent. alcohol ; the solution must remain clear up to an addition of 10 vols.

With regard to these suggestions we wish to point out that the maximum limit of the sp. gr. should be raised to 0·915 at least ; we have occasionally—although very exceptionally—known it to be still higher (up to 0·920). The maximum limit for the rotation has also been fixed too low, for only recently we examined samples of guaranteed pure oils, expressly distilled for us in Ceylon, which gave only—16°. It would likewise be impossible to maintain strictly the requirements relating to solubility, rather would it be necessary to admit that the diluted solution may turn slightly opalescent, for an absolutely clear solution is an exception.

In connection with the fixing of constants, the journal referred to also gives a prescription for the determination of geraniol, which, although differing somewhat from that in its precursor, the *Chemist and Druggist*, shows an equal determination to pass by in silence everything that has recently been published on the subject of the acetylation of citronella oil, and to set up some "special method." There can be no doubt that our own prescription, *which is founded upon experimental basis*, must be familiar to the English chemists who are concerned in this matter, and it is therefore surprising that in spite of this knowledge they should again persist in taking a course of their own. Such a proceeding certainly cannot help the problem forward. We can only repeat again and again that in the case of citronella oil in particular it is necessary to work by a clearly-defined method if it is desired to obtain results which shall correspond to the actual percentage of total geraniol in the sample, and which shall be comparable with each other. In our last Report we gave a detailed account of our method, the trustworthiness of which has been proved by tests with mixtures of known geraniol- and citronellal-content, and we may, therefore, content ourselves here with reference to that Report. It goes without saying that in our laboratories our estimations are exclusively made according to this method, for which reason we refrain from quoting the English methods here.

Lemongrass Oil.

In one of our earlier Reports we described several lemongrass oils produced in the Jalpaiguri District of Northern India. Mr. J. H. Burkill, of Calcutta, who sent us the samples of the oils in question at the time, has now briefly informed us in writing that this particular species of grass has been identified since then as *Cymbopogon pendulus*, Stapf. This information is of particular interest because up to the present only two grasses have been known to produce lemongrass oil, namely *C. flexuosus*, Stapf, which yields the Malabar oil, and *C. citratus*, Stapf, the parent-plant of the sparingly-soluble, so-called West Indian lemongrass oil. The oil from *C. coloratus*, Stapf, which is also one of the lemongrasses, has only lately become known, and is said to possess characteristics resembling those of a mixture of lemongrass and Java citronella oils.

ARTIFICIAL RUBBER

is a substance which the chemist can make, even as he can make artificial diamonds ; but during a number of years of experiment the one process has remained nearly as expensive as the other. But no chemist will be surprised to find some morning that artificial rubber has been made in a way and on a scale to ensure commercial success for the product. There is a report, which we repeat with all the reserve due to a fact that cannot be scientifically verified, that Badische Anilin-und-Soda Fabriken has at last succeeded in making artificial rubber on a commercial scale. The "Badische," as it is shortly called, is the greatest of the German chemical manufactories, and the one that is not uncommonly held up by Presidents of the British Association as an example, which the British manufacturer should imitate, of the application of science to industry. It has a staff of a hundred chemists, some of whom are engaged in pure research ; and the scope of their work may be inferred from the fact that this organisation, which first wrested the manufacture of the anilin dyes from Great Britain, is the origin of the larger number of the modern drugs used in medicine, from phenacetin to sulphonal and adrenalin, It is also the firm which, after spending a quarter of a million of money in chemical experiments, succeeded in making artificial indigo. It is small wonder that anticipation should look to the Badische for the first announcement that the making of indiarubber can now be transferred from the laboratory to the factory. The number of patents known to be associated with the synthesis of rubber that have recently been taken out by the firm has given substance to the idea.

It will be by no happy accident that the result will be arrived at, but as the consequence of patient experiment which is part of the history of chemistry. The first step was taken twenty years ago or more, when some chemist, untrammelled by any commercial aspiration, found at last what was the essential constituent of caoutchouc—or of indiarubber as we may popularly call it. To Harries belongs the chief credit ; though Greville confirmed his patient analysis by evoking the essential substance "isoprene" from heated rubber. Now "isoprene," a hydro-carbon, is a chemical compound whose molecules are a combination of five atoms of carbon with eight of hydrogen. The chemist now, so to speak, knew where he was. Hitherto he might have made artificial rubber in his crucibles, but he would never

have been sure of it. "Isoprene" identified it. After this for some years chemists experimented with ways of turning back tho isoprene into rubber. Tilden once found a bottle of isoprene in his laboratory that had somehow converted itself partially into rubber, or caoutchouc; and he believed he had found a less accidental method by treating it with hydrochloric acid. But other chemists tried for years in vain to repeat Tilden's experiments, and if any firm, or any chemist, did produce what he called artificial rubber, the production was received with deep suspicion rather than congratulation. In January of last year the indomitable Harries took out a patent for heating "isoprene" with strong acetic acid in such a way that the desired caoutchouc was produced—but it was nearly as precious as rubies. What, therefore, was wanted—perhaps we should say *is* wanted—was cheap "isoprene." Now there is another very common hydrocarbon, whose molecule, combining ten atoms of carbon with sixteen atoms of hydrogen, is clearly indicated as the suitable parent of "isoprene." It is oil of turpentine. The problem of altering $C_{10}H_{16}$ into C_5H_8 is therefore the real problem of artificial rubber. We can put it much more lengthily by saying that it may be done rather after the following way. Oil of turpentine contains pinene. Pinene heated, gives dipentine. Standinger and Kleven, by heating dipentine in a partial vacuum, have extracted "isoprene." "Isoprene" heated with strong acetic acid gives rubber. Cheapen the process at all or any of these stages and the trick is done.—*M. Post*, Nov. 3.

MANURING FOR RUBBER.

The Department of Agriculture has recently been asked by a number of planters to advise as to what manures to apply to rubber trees and in what quantities they should be used. On the majority of plantations it is doubtful whether any manuring is required. There are a number of places, however, where the growth or the general vigour of the trees is not equal to that on others. In these places, provided it is not the cultivation or the drainage that is at fault, manuring may prove of advantage. Cultivation in most places will be found of greater advantage than manuring. If every rubber field could be changkolled twice a year or receive an equivalent cultivation with ploughs, disc harrows, etc., it is certain that both the immediate and permanent benefits would be great. Of course with old trees which have formed an interlacing root system near the surface of the soil such cultivation would be dangerous, but with young plantings cultivation is strongly recommended. On fairly flat lands which have been thoroughly cleared of timber and stumps, probably mechanical cultivation by ploughs or disc harrows will be found more economical and more effective. The following recommendations for manurial treatment have been drawn up by Mr B J Eaton, Agricultural Chemist, Federated Malay States. It must be borne in mind that they are based on general principles and are not the result of experiments. Manurial experiments have been started by the Department of Agriculture, but reliable results will not be obtainable from them for some years. It is proposed to publish similar notes for other types of soils.

Manurial Treatment for Para Rubber on Heavy Clay Soils.

The following treatment is to be recommended for clay soils :—

Slaked lime ...	½ to 1 ton per acre	
Basic Slag (phosphate manure) ...	350 lb.	do
Ammonium Sulphate	150 lb.	do
Potassium Sulphate...	100 lb.	do

The lime and basic slag should be applied about a month or two months before the other manures as they decompose Ammonium Sulphate. The Ammonium Sulphate and Potassium Sulphate should be mixed together and then mixed with earth and subsequently spread. If concentrated manures are used they frequently injure the roots with which they come in contact, and the earth is added as a diluent. With trees one or two years old it is preferable to dig a shallow trench (4 to 6 inches deep) at a radius of 2-3 feet round the tree, sprinkle the manure round and subsequently cover with earth again. With older trees, where the roots interlace, the manures may be broadcast and the whole surface forked over.

The following can be used in place of Ammonium Sulphate :—

Castor seed cake, or
Linseed cake, or
Cotton seed cake or
Para seed cake, or
Ground-nut cake.

These should be applied at the rate of about 600 lb. per acre. If it is found that the cost of the quantity recommended is cheaper than the Ammonium Sulphate, I would recommend their use. Instead of Potassium Sulphate may be employed.

Kainit (12 per cent Potash) 400 lb. per acre, or

Potassium Chloride 100 lb. per acre.

The cost of the above quantities should be compared with that of 100 lb. of Potassium Sulphate. Instead of Basic Slag, Perlis Guano or other Phosphatic Guano may be substituted. Perlis Guano (containing 15 per cent Phosphoric Acid) at the rate of 500 lb. per acre, should be very economical, as its price is only $25 per ton. In the first instance as a trial I would suggest the use of the most economical fertilizer, until more is known of the different effects on the Para rubber tree on different soils of the various nitrogenous, phosphatic or potash fertilizers. The average cost per acre of the above formula excluding lime, will amount to $20 to $25 per acre. This does not include transport, freight or labour. Lime can be purchased at 80 cents to $1 per picul.

L. Lewton Brain.

—*Agricultural Bulletin*, No. 11 for Nov.

RUBBER FUTURE DELIVERY DEALINGS.

The following circular on plantation rubber has been issued by Mr. William Schultz, manager on behalf of the London Producing Clearing House, Limited: The company will be prepared, on or after November 6 next, under their customary rules for deposits, margins, etc., to register contracts for plantation rubber delivered in Antwerp in conformity with the rules for delivery fixed by the Caisse Internationale de Liquidation et de Garantie des Operations en Marchandises, laid down in their Règlement pour les affaires à termes en Caoutchouc de Plantation. An abridged extract of these rules will be found below. For further information please apply to the company's offices, where also a limited number of complete copies of the Règlement may be had at 6d. each.

The unit of contract will be 2,500 kilos net, equal to 5,510 lb. Samples of type plantation rubber may be seen at the Company's offices. Prices will be in English currency per lb. net less 2 per cent. discount, or in francs and centimes per kilo net less 2 per cent, at the option of contracting parties.

The deposit is, until further notice, £100 for each contract of 5,510 lb., payable by both buyer and seller. Margins will be regulated on the basis of the quotations fixed daily by the company's brokers. Business will be accepted only from the company's authorised brokers. The minimum rate of brokerage will be ⅛ per cent for buying and ⅛ per cent for selling. The company's fees are 12s. on each side for every unit of contract, and are payable by contracting parties.

Pending the establishment of a secured London terminal market for rubber, we are glad to offer our clients an opportunity to have a guaranteed contract for this article, and we have much pleasure in expressing our sense of the courtesy shown us by the Caisse Internationale in this matter.

From the above it will be seen that the Antwerp rules are being followed, and that the delivery of rubber is to be in Antwerp unless otherwise stipulated. Strange as it may seem, although London is the largest market for rubber there is no machinery here for secured terminal contracts in this article.

The necessity for such contracts in the case of rubber has been recognised on the Continent for some time. Antwerp has taken the lead and established an up-to-date market, while Hamburg is making active preparations, which will shortly be completed, with a similar object in view. The present action of the London Produce Clearing House is intended to offer a remedy and to retain business here which would otherwise go abroad, and it is hoped that this action will soon be followed by an arrangement in London similar to that which prevails at Antwerp.

The extract of Antwerp rules is as follows: The basis of contract is type plantation, Hevea Brasiliensis, first latex unsmoked in thin crepes, stored in Antwerp in a warehouse admitted by the Caisse Internationale (for the option to deliver at other ports see below). Rubber must be sound and of fair and merchantable quality, packing free and in good condition. Every tender must be accompanied by a certificate of quality. Seller has the option to tender, subject to a scale of differences fixed by experts: (1) Plantation rubber, Hevea Brasiliensis, first latex consisting partly or wholly of smoked or unsmoked in all sorts, forms, preparation and shades. (2) Rubber, consisting entirely of hard cure fine Para, with the exclusion of Peru, Rio-Negro, and—or—Tapajos.

Sellers may not deliver: (1) Lots found by experts to be on the average more than 1fr. per kilo inforior to type. (2) Lots consisting of rubber "suranne."

Allowances for inferior rubber will be credited to buyer in full. In the case of superior rubber the maximum allowance credited to seller will be 1fr. per kilo.

Types will be deposited with the Caisse Internationale. Samples may be had against payment. The difference between basis of contract and Para will be fixed every month, not later than the 25th, to serve as guidance for experts during the next month (for deliveries in November, 1911, it is 0.90fr. per kilo, equal to about 3⅞d. per lb.) Certificates of quality are valid as long as the units they represent remain intact, but not for more than twelve months for hard cure fine Para, and six months for plantation first latex. The fees for valuation are 125fr. per tender. Copies will be delivered free of charge. If types are altered, the new types will be applicable only for such month for which no contracts are registered.

Sellers may tender at the earliest three clear working days before the first working day of the month for delivery, and not later than four clear working days before the last working day of the month of delivery. Buyer may take up tender at once, but not later than three clear working days after date of tender. Payment is made to the Caisse Internationale, who settles with seller within twenty-four hours.

Seller is entitled to carry over his contract to the following month, informing the Caisse Internationale of his intention not later than five working days previous to the end of the month of delivery, and paying a penalty of 5 per cent. on his contract, calculated at the quotation of the date of his notification. This prolongation cannot take place more than three successive times on the same contract. The penalty is payable to last buyer, who is bound to accept it, and to have his contract carried over accordingly.

Sellers shall also have the option to deliver stored wholly in a warehouse admitted by the Caisse Internationale: At London on payment of a fine of 175fr. per contract. At Liverpool on payment of a fine of 200fr. At Havre on payment of a fine of 175fr. Valuations for these rubbers must take place in Antwerp, and all extra charges incurred will be paid by seller. The intention of seller to deliver in these places must be notified to the Caisse Internationale not later than the 15th day of the month of delivery.

If one-fourth of the Antwerp stock be destroyed by fire or any other catastrophe, any seller who shows that his tenders were thus destroyed may defer delivery for thirty days without paying any penalty. After that delay he may be called upon to deliver.

All disputes, of whatever nature, will be submitted for arbitration to the Chambre Arbitrale et de Conciliation pour Caoutchouc à Anvers, and all contracting parties are bound to abide by their award and not to go to law.—*H. & C. Mai*, Nov. 3.

THE SMOKE CURE FOR RUBBER.

Little is known in Java about the cure of latex by smoking, this being the primitive method adopted nearly a century ago by the Amazon Indians and still survives, in the treatment of wild grown Hard Para. Dr. K Goeter, writing to the Sumatra *Post*, explains the Brazilian treatment of the latex, and goes on to say: "It is, however, most noticeable and, according to the experiences of Trillat and other investigators, that wood smoke contains another substance (besides creosote) having strong conserving properties, namely, formaldehyde, which, dissolved in water, is the formaline or formal of commerce. It was therefore thought probable that this stuff would be found in small quantities in smoked rubber. This was, indeed, found to be so. With the help of various sensitive reactions, I could undoubtedly show the presence of formaldehyde in smoked rubber sheets so that by reason of this result it may be taken that the conserving work of smoke on rubber must at least be partly attributed to the presence of formaldehyde in the smoke. In the development of smoke, it would be well to bear this in mind, by endeavouring to get a smoke that is as rich as possible in formaldehyde. Now it has been found that organic substances, for instance, sugar, will, through incomplete combustion, produce more formaldehyde when they are placed in contact with metals. From this we may also conclude that smouldering wood in contact with a metal, such as iron, will give a smoke with a higher percentage of formaldehyde than when that contact with a metal does not exist. The wood must smoulder; therefore, it must burn without flame, and this is only attained by limiting the admission of air. If there is too much air, less smoke is obtained and more fuel is used up; so that it is less economical from two points of view. It might bo well also for planters to bear in mind that in smoke a poisonous gas, the well-known carbonicoxida is formed, of which the relative quantity increases under the last-named conditions. From a hygienic point of view, the health of the coolies working continually in an atmosphere of smoke should be considered. Whether smoking has a direct influence on the physical properties, for instance, on the elasticity of the product, I should not dare at present to decide. As a fact, it can only be said now that smoked rubber keeps better and is not so liable to mould as unsmoked rubber. As a rule, a higher price is paid for smoked rubber on this account."

COPRA AND VANILLA IN THE SEYCHELLES.

Administration Report for 1910.

The export of copra has risen steadily, and with improved methods of cultivation should continue to progress. The export of soap and other products of the coconut palm will only show an increase when there is a considerable fall in the price of copra, but the quantity of nuts collected is steadily advancing. A moderate crop only of vanilla was harvested. Vanilla plantations are being gradually restricted to the higher zones of the mountains owing to successive dry seasons. With the legislation in France and the United States restricting artificial substitutes, there has been a continuance of the remunerative prices of the past two years, and as there is a growing reluctance on the part of manufacturers to use the artificial vanillin there seems no reason why vanilla cultivation should not continue to form one of the principal industries of the Colony. I am aware that this opinion is contrary to that of a number of experts. When in England in 1907, I was told by a distinguished man of science, whose researches have been mainly connected with tropical products, that plantation vanilla was in its death throes. In that year the Seychelles crop realised a million rupees, the price rose steadily (apart from a temporary drop in 1908) and good prices have ruled ever since. It is not as if vanilla has to be cultivated at the expense of less capricious products: the orchid will grow and thrive where coconuts and rubber will not. It is true that the yield fluctuates considerably, but even the famine harvest of 1909 (11 tons) realised over Rs. 200,000, and was third in value in the exports for that year.

The standard of cultivation is being steadily raised as is evidenced by the regular increased yield of coconuts. The planting of Para rubber has continued on a more extensive scale owing to the acquisition of a number of estates by a company styled the Seychelles Rubber and Coconut Estates Co., Ltd. This company was floated during the year, and purchased a number of good estates. The price paid for the land was relatively high, but the vendors accepted a large proportion of the purchase price in shares. Under the present energetic management the operations of the company should have a beneficial effect on the agricultural progress of the Colony.

INDIAN AND CEYLON TEA SHARE VALUES.

Substantial Rise During Last Quarter.

From the following figures, compiled, as usual, by Mr. George Seton, of the Indian Tea Share Exchange, Winchester House, E.C., it will be seen that the value of the shares of the forty-five representative tea-planting companies selected by him for particular observation, after dipping a little during May and June rose steadily during the quarter ended September 30th, and stood at a very high level at the beginning of October.

Face value of 45 Companies' shares			£9,500,000
Market value,	1st Sept., 1902	(lowest)	6,050,000
,,	1st Jan., 1904		8,200,000
,,	1st Jan., 1905		7,200,000
,,	1st Jan., 1906		8,950,000
,,	1st Jan., 1907		9,650,000
,,	1st Jan., 1908		10,500,000
,,	1st Jan., 1909		9,950,000
,,	1st Jan., 1910		11,550,000
,,	1st April, 1910		13,850,000
,,	1st July, 1910		14,500,000
,,	1st Oct., 1910		14,450,000
,,	1st Jan., 1911		16,400,000
,,	1st Feb., 1911		15,500,000
,,	1st April, 1911	(corrected)	16,010,000
,,	1st May, 1911		15,900,000
,,	1st June, 1911		15,900,000
,,	1st July, 1911		15,700,000
,,	1st Oct., 1911		16,550,000

As the grand total of the share and Debenture capital of the 170 or so companies altogether registered in the United Kingdom amounts to about double the above figure, the fluctuations of the entire volume may be thus approximately computed :—

Face value of 170 Companies		£19,000,000
Lowest value,	1st Sept., 1902	12,100,000
Market value,	1st Jan., 1905	14,400,000
,,	1st July, 1905	15,400,000
,,	1st Jan., 1906	17,900,000
,,	1st July, 1906	17,800,000
,,	1st Jan., 1907	19,300,000
,,	1st July, 1907	20,900,000
,,	1st Jan., 1908	21,000,000
,,	1st Jan., 1909	19,900,000
,,	1st July, 1909	21,300,000
,,	1st Jan., 1910	23,100,000
,,	1st July, 1910	29,000,000
,,	1st Oct., 1910	28,900,000
,,	1st Jan., 1911	32,800,000
,,	1st Feb., 1911	31,000,000
,,	1st April,1911	32,100,000
,,	1st July, 1911	31,400,000
,,	1st Oct., 1911	33,100,000

The Tea market has continued steadily to improve as the autumn advanced, with not only the commoner and cheaper grades of tea rising in price, but nearly all other grades, especially the finest, sharing in the improvement. Good trade at home has been supplemented by increasing inquiry from abroad, especially from Russia, but also from Belgium and Germany and other central European countries, where recently great efforts have been made to direct public attention to the merits of good Indian tea, which efforts are now beginning to reap a tardy reward.

The share market, taking its cue from that for the produce, has ruled strong and business has latterly been on a very large scale, while values, have, with only a few exceptions, advanced smartly, though it will be seen from the above figures that the aggregate value for the first time exceeded the figure of January 1st last. The advance during the nine months has been uneven—several leading shares were now standing lower than they did last Christmas. In other cases, however, the advance has been quite phenomenal. Ceylon shares have for the most part, declined, owing to the collapse in rubber, in which product most of them have an interest, as well as in tea.—*F. Times*, Oct. 31.

BLIGHT-RESISTANT COFFEES.

Since the advent of the coffee blight (*Hemileia vastatrix*) into the Philippines some twenty-five or thirty years ago, it has been practically impossible to raise even a fair crop of coffee below 2,000 feet elevation. This blight destroyed the coffee industry not only in the Philippines but in Java, Ceylon and the Malay Peninsula at about the same time that it reached this Archipelago.

An attempt is being made now by several of the old coffee countries to discover or create one or more varieties of coffee which will be resistant to this fungus, and it is believed there is some hope in some of the new hybrids of robusta coffee (*Coffea robusta*). This Bureau now has growing at the Lamao experiment station a considerable quantity of this coffee, and a littte later seed will be distributed to any one who wishes to experiment with the variety. However, like several of the non-commercial coffees this robusta does not have a first-class flavour, thought it is in some respects better than that of either Liberian (*C. liberica*) or the Inhambane coffee of Mozambique. Another trouble with the new coffees is that they are for the most part very weak in caffein, the active principal of the beverage—some of them possessing no stimulating qualities whatever. —*Philippine Agricultural Review*, for Oct.

RUBBER IN BRITISH EAST AFRICA.

In the September issue of "L'Agronomie Tropical" some interesting particulars with regard to rubber in British East Africa are given by Mr A C MacDonald, the Director of Agriculture there. The larger part of the rubber so far exported, he mentions, has consisted of that obtained from indigenous species of Landolphia, which are to be found in the coastal districts of Takaungu, Witu, and Mwele, and on the andi plateau, which is 6,000 feet high. So far, the methods of tapping have been so crude as annually to reduce the extent of the rubber producing districts, the plants, in many cases, being bled to death. In the forests of Nandi, coagulation by sprinkling the wound with salt after the incision, has had to be abandoned, as the monkeys come along, lick off the salt, and gnaw the lianes. Endeavours are being made to give the plants a rest, in order to permit of their regeneration, and the effect of this treatment is to be carefully noted. Another form of rubber is obtained from the Mascarenhasia elastica, but its value, up to the present, is not exactly known. In some of the more favourable localities, Hevea braziliensis (Pavia) has some chance of success, but as a general rule it does not grow very well, especially near the coast and the lakes. Ceara (Manihot Glaziovii) does extremely well near the coast to the north and south of Mombasa, and in the region extending from Mazeras and Changamwe to Ribe, as well as in a large part of the Lake district, as experiments conducted during the last three years have shown. Fifteen hundred to 2,000 acres have already been planted and the plantations are constantly extending. So far tapping has beendone for sample purposes only, but the rubber obtained from trees two to two and a half years old has been valued at 5s. a lb.